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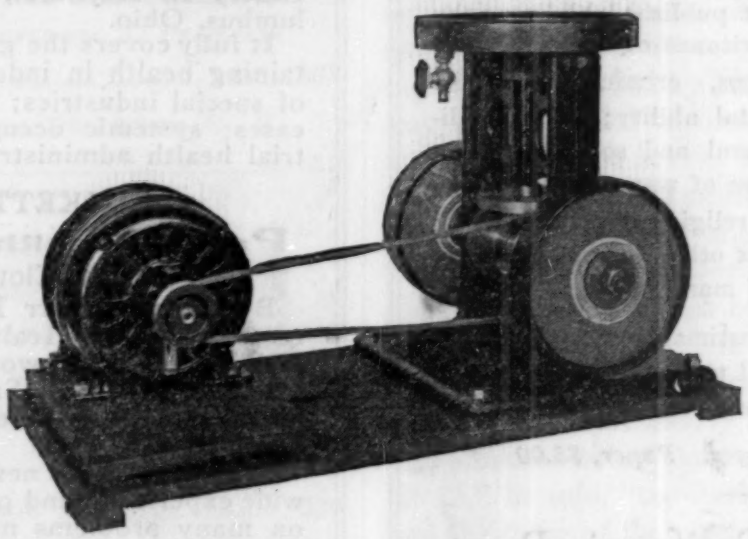

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A RETROSPECT[1]

IT is the custom of our association that the annual presidential address should be delivered, not by the actual president, who assumed the responsibilities and honors of his office at the close of the last meeting a year ago, but by his predecessor, who by courtesy is termed the "retiring president" although as a matter of fact he is not "retiring" but "retired." He has to the best of his ability sustained the responsibilities of the presidency and has been relieved of them, he has enjoyed the honor of the position and has retired beyond the range of the spot-light only to be dragged into it once more with even greater responsibilities than before. Professor Dana in his presidential address of nearly seventy years ago describes this situation more eloquently than I can. "In most offices," he said, "the duties terminate with the office, and the thing of the past, the ex-officer, is to the present an unknown quantity. But it is not so with your president. Science . . . sternly drags forward its reluctant presidents to their hardest trial when they have ceased to be, to a judgment after death severer than that of Rhadamanthus." And Professor Asa Gray nearly twenty years later naturally and happily employing a botanical metaphor, compared the president to a biennial plant: "He flourishes for the year in which he comes into existence and performs his appropriate functions as a presiding officer. When the second year comes round, he is expected to blossom out in an address and disappear."

This arrangement has its advantages in that it affords what should be ample time for the preparation of such an address as the occasion and the position demands; for a speaker from this rostrum is confronted with the responsibility of speaking as one having authority, as a representative of science and while he may not have the ability to duly mix "reason with pleasure and wisdom with wit," he may be expected to set forth with surety and clarity the faith that is in him as to the achievements and progress of science, or at least of that department of science which he cultivates. Few can see this responsibility approach with cool, calm composure and assurance and alas! the very fact that one has apparently ample time for the preparation of one's pronouncements

[1] Address of the president of the American Association for the Advancement of Science, Seventy-fifth Annual Meeting, Cincinnati, 1923.

with most of us merely leads to the postponement of that preparation until in the fulness of time it is forced upon one. I confess that this has been my own case and that I am one of those "who time gallops withal." I make this statement not in extenuation but in explanation.

But while I fully appreciate the burden of responsibility that rests upon my shoulders it is with a peculiar satisfaction that I appear here to-night. That I have recently held the highest office in the gift of this association is in itself a source of the greatest pride and satisfaction, but these feelings are enhanced by the fact that I am a witness for the broad spirit of catholicity shown by the association in that it declines to recognize geographical boundaries to scientific endeavor. My presence on this platform is the outcome of a recent meeting of the association on Canadian soil and is to be regarded as a compliment to the association's hosts on that occasion, the University of Toronto and the Royal Canadian Institute. We esteem it an honor that we should have been permitted to act as your hosts, we rejoice in such invasions across our boundary, invasions that tend to maintain and strengthen that *entente cordiale* which, with some slight and temporary perturbations, has characterized the relations of the two countries for well over a century. Let us hope that a century hence a future president from the neighboring Dominion may speak in similar words—omitting reference to perturbations, though that seems almost too much to hope for.

The meeting of 1921 was not the first but the third meeting of the association in a Canadian city, nor am I the first Canadian to be honored with its presidency. At the meeting in Montreal in 1882 the presiding officer was Principal J. W. Dawson, of McGill University, distinguished for his contributions to Canadian zoology and geology and one of those who, like Louis Agassiz, could cultivate with equal success two of the great fields of science that were then included under the term natural history. How these fields have been extended in the forty years that have elapsed and how zoologists and geologists, ever pushing onward the frontiers of their respective territories, have drifted apart, until now each has developed a peculiar dialect which the other finds difficulty in understanding! This is one of the penalties of increasing knowledge.

There is a third president of the association who may perhaps be claimed as a Canadian, I mean Professor T. Sterry Hunt, a distinguished chemist and mineralogist. He was born, it is true, south of the Canadian boundary and the closing years of his life were passed in his native land; but for quarter of a century he was an active and valued member of the Geological Survey of Canada, under Sir William Logan, the first director of that survey. Professor Hunt was the acting president of the association at the Troy meeting in 1870, at which time he was still a member of the Canadian Survey.

I call attention to these facts only to emphasize the broad spirit of fellowship that characterizes this association. Its object is the advancement of science, and it is ready to extend the privileges of its meetings and the stimulus that they bring, wherever, upon this continent, they may be welcome. Canadian scientists and Canadian science have always been as welcome at the association's meetings as that brand of scientist and that brand of science that is produced in the United States. Furthermore arrangements are now on foot whereby it is hoped that the influence of the association in promoting the advancement of science will be extended to the republic that lies south of the Rio Grande and the association is thus justifying its title of American in a fuller and broader sense than that usually attached to that designation. It is working toward the realization of the ideal expressed in its first by-law, which lays down the principle that "The association is American, its field covering North, Central and South America. Inhabitants of any country are eligible to membership." It strives for the advancement of science, wherever cultivated, as a potent factor in civilization.

This broadening out policy is one that has been inherited by the association from its immediate ancestor, The American Association of Geologists and Naturalists. This association, which was primarily one of geologists, was organized in 1840 as the result of the inauguration of geological surveys of various states of the Union. Those engaged in these surveys felt the necessity for cooperation and discussion that there might be uniformity in the presentation of the results of their work. Soon the zoologists and botanists—the naturalists—were drawn in. Some chemists from the first had been included in the association but, in time, their department became a large and important one and finally the meteorologists found a congenial atmosphere in the association. So the scope of the interests of the association broadened out and at its 1847 meeting, held in Boston, it was decided that it should assume a title more indicative of its scope, and at the meeting of 1848, held in Philadelphia, it became the American Assocation for the Advancement of Science and in keeping with the new title it extended its membership to include general physicists, mathematicians, economists and engineers.

Thus our association had its beginning more than seventy-five years ago and at the close of its inaugural meeting it had a membership list of 461, an excellent showing, especially when it is recalled that in the early years there were certain restrictions of the membership that were subsequently made less definite. From the beginning, however, it has had the support

of the leading scientists of the country; on its first council were Professor Jeffries Wyman, Professor Benjamin Peirce, Professor S. S. Haldeman, Professor Joseph Henry and Professor Louis Agassiz, names that we of to-day recall with reverence and admiration, names that will forever stand in shining letters on the records of scientific achievement in this continent. With such men in control of its affairs success was guaranteed to the young association; it at once became the rallying ground for scientists in all departments of research and in turn attracted those who were interested in scientific progress without taking active share therein. For, as Professor Bache remarked at a later meeting, "Who will say that they do not return wiser, better, more zealous according to knowledge from a meeting—with Henry, Peirce or Agassiz?"

This first meeting is of interest too from the standard of papers presented. Foremost among these was an exhibition by Lieutenant Maury of charts of the North Atlantic showing the prevailing winds and currents, deduced from the study of many thousand old log-books, an earnest of what was to develop later into the classical "Physical Geography of the Sea." Lieutenant Maury demonstrated clearly the relation of intensive scientific investigation to practical results, for his charts indicated that the route usually followed by southbound vessels did not allow them to profit by the most favorable winds and by selecting another route, deduced from his observations, and testing it by a number of vessels, it was found that the passage could be made in three quarters the average time taken by vessels following the older recognized route. The introduction of steam navigation in the years that followed detracted greatly from the direct utilitarian importance of Lieutenant Maury's investigations, but he had laid the foundations for our modern science of oceanography and had established principles that, for a time at least, greatly favored commercial intercourse with distant portions of the globe, especially that between this country and the east and that between Great Britain and her Australian colonies. The voyage from Liverpool to Australia in earlier days usually occupied some four months or more, but in 1854 a sailing vessel, following the course advocated by Maury, made the passage in sixty-three days, and that course even in these days of steam, is still largely followed.

Another important paper presented at the first meeting was that on "The Sediment of the Mississippi River" by Dr. M. W. Dickeson and Mr. Andrew Brown, a summary of deductions based on observations extending over eighteen years, and mention should also be made of a series of papers by Agassiz, fresh from his expedition to Lake Superior, on whose shores his practised eye found abundant evidence of glaciation and whose waters yielded to him a rich harvest of fishes which he could compare with the fresh-water fishes of Europe and those of the Spix collection from Brazil that he had already studied.

One may not linger over this first meeting, nor may one pause to note the many interesting contributions presented at later meetings. The activity of the association in these early days was sufficiently great to warrant the holding of two meetings in each of the years 1850 and 1851 and the first of those of 1851, the fifth of the association, was held in this city in the month of May, under the presidency of Professor Alexander Dallas Bache, the distinguished and efficient director of the Coast and Geodetic Survey. The college professor of the fifties was not the migratory bird he has since become, nor were there then the inducements to extensive peregrinations that now exist. The colleges and scientific institutions were ranged along the Atlantic sea-board, the great State Universities, now such important factors in our scientific progress, had not yet arisen, although the University of Michigan had opened her doors in 1841 with a staff of two professors and with eleven students in attendance. All previous meetings of the association and those of the parent society had been held in cities of the Atlantic coast; the May meeting of 1851 was the first held beyond the Alleghanies and in 1851 a journey beyond the Alleghanies was not one to be lightly undertaken, it was an adventure. It may interest you to-night to hear of the expectations of Professor Henry and of the realities he found in attending the first meeting of the association in this city. He confessed that it was the first time that he had been west of the mountains and went on to say that "He expected to see a boundless, magnificent forest world, with scattered dwellings and log-cabin villages and energetic New England-descended inhabitants; he thought to find Cincinnati a thriving frontier town, exhibiting views of neat frame houses with white fronts, 'green doors and brass knockers,' but instead he found himself in a city of palaces, reared as if by magic and rivaling in appearance any city in the eastern states or of Europe." Professor Henry's expectations might have been realized some fifty years earlier; in the meantime Cincinnati had grown to the stature of the Queen city of the West and with her material progress had not failed to make provision for the cultivation of the arts and sciences in such organizations as the Mechanics Institute, the Academy of Natural Sciences, the Mercantile Library Association and the Young Men's Lyceum of Natural History, all of which Professor Henry mentioned with the remark, "These are the pride of Cincinnati—these her noblest works."

The first Cincinnati meeting was in itself a notable event as the first invasion by the association of what

was then still regarded as the West. But it was made still more notable by two other happenings. At the preceding meeting at New Haven, Professor O. M. Mitchell, to whose enthusiasm the erection of the original Cincinnati Observatory was due, and who was its director until 1859, reported that he had invented and constructed two instruments by which in a single night as many accurate determinations of right ascensions or declinations might be made as were made at the Royal Observatory at Greenwich in a whole year. This was rather a startling claim to be made by one working apart and with few of the resources available at the more richly endowed observatories of the East and of Europe, and a committee was appointed with Professor Peirce as its chairman to investigate the claim and report upon it at the Cincinnati meeting. The committee found that as to the apparatus for observing right ascensions the claim was fully justified and while a sufficient number of observations had not been made with the apparatus for determining declinations to warrant a definite statement regarding it, yet it was regarded as being perfectly correct in the principles of its construction. "The committee," I quote from its report, "are not aware that the history of Astronomical Science exhibits a more astounding instance of great results produced by what would seem to be wholly inadequate means. With the ordinary tools of a common mechanic and with insignificant pecuniary outlay an isolated individual has aspired to rival the highest efforts of the most richly endowed institutions—and his aspirations have been crowned with success." The fame of the Cincinnati Observatory was at once established, for the genius of its director had developed methods of observation that were later adopted by all the leading observatories of the world.

That was the *great* happening at the first Cincinnati meeting. The other one I would mention is of less moment in that it concerns only ourselves; it was the appearance upon the scene for the first time of that supremely important official, known as the permanent secretary. Presidents may and do come and go, each "struts and frets his hour upon the stage, and then he disappears." Not so the permanent secretary, he goes on forever. He came into being at the first Cincinnati meeting in the person of Professor Spencer Baird, and he has continued in existence ever since, in various incarnations it is true, assuming for a time the lineaments of Professor Lovering, then those of Professor F. W. Putnam, then those of Professor L. O. Howard and finally those of the present efficient holder of the office. With each incarnation the responsibilities of the office increased and I need not say, that in each these responsibilities were fully and satisfactorily met.

Thirty years were to elapse before the association again met in Cincinnati, that is to say, it was not until 1881 that a second meeting was held in this city, this time under the presidency of Professor G. J. Brush, of Yale University. We have seen that the first meeting was made memorable by an important change in the administration of the association; the second meeting was made memorable by the adoption of a new constitution involving some important changes in organization. Up to 1875 two sections had been tacitly if not actually recognized in the association, Section A including mathematics, physics and chemistry, and Section B including natural history. In the year mentioned the disruptive tendencies of specialization began to manifest themselves and the chemists segregated in what was officially termed a permanent subsection, a similar action was taken by the anthropologists, one year later the microscopists decided that their highly magnified world required a subsection for itself and five years later still the entomologists deemed it necessary that they should betake themselves to a special hive. For each of these four permanent subsections there was a chairman, while the presiding officers of the two original sections were designated by the more dignified term of vice-presidents.

By the new constitution adopted at the second Cincinnati meeting the permanent subsections were abolished and at the same time the association was divided into nine sections, each of which was presided over by a vice-president, who was required each year to give an address before his section. The nine sections were those of A, Mathematics and Astronomy; B, Physics; C, Chemistry; D, Mechanical Science; E, Geology and Geography; F, Biology; G, Histology and Microscopy; H, Anthropology, and I, Economic Science and Statistics. Mark the significance of this step. It was a recognition of the tendency toward specialization that had become so marked a feature in the science of the day, and established a policy that has prevailed up to the present. That is why the second Cincinnati meeting was a notable one. We are now entering upon the third Cincinnati meeting—that it too may be a notable one is what may be expected from the past, but whether its notability will depend on new developments of policy or on its records of scientific achievement we must wait to see.

The policy of specialization thus inaugurated in 1881 was bound to lead to further developments. The first modification of it, however, was in a retrograde direction, consisting of the absorption of Section G, Histology and Microscopy, into Section F, Zoology, in 1885. Looking back from our present standpoint it is difficult to understand why this section G was ever established and its absorption was a step to the good. But it was not long until Section G was re-established by the division of the section of biology

into sections of zoology and botany (1892). Then followed in 1900 the establishment of Section K for physiology and experimental medicine and in 1906 Section L was created for education and at the same time the title of Section H was changed to anthropology and psychology. Section M for agriculture was established in 1912 and in 1921 astronomy was divorced from mathematics, psychology from anthropology and new sections for historical and philological sciences and for manufactures and commerce were created, bringing the total number of sections up to sixteen. There are still some letters of the alphabet available for future sections.

Nor was this recognition of specialization the only sign of segregation in the association. A geographical segregation was bound to come as the sphere of influence of the association grew. It has come; for in 1914 a Pacific Division was established and in 1920 a Southwestern Division, each with its own constitution and officers, each holding its own annual meeting and yet remaining bound to the parent association by the closest ties of membership and purpose. If the vision that our first by-law calls up is to be realized it is evident that other divisions must be recognized, indeed, as has already been indicated, the establishment of a Mexican Division has already come to be a matter for deliberation. And what a vision it is that our first by-law calls up—a federation of divisions extending from the shores of the Arctic Ocean to Cape Horn, marching under one banner and with one purpose, the advancement of science and civilization!

So with segregation integration was also taking place. But the principle of segregation that the association felt itself obliged to recognize was not adopted as extensively as some groups of scientists desired and a tendency developed for these groups of specialists to form their own societies independent of the association. It became evident that if such secessions went on the representative character of the association would be endangered. Specialization had come to stay; indeed, it was bound to increase with the growth of the very object to which the association was pledged, the advancement of science. There were advantages for these societies in holding their meetings in conjunction with the association and it was to the advantage of the association that they should do so. That the mutual advantages might be ensured to some extent the council of the association was empowered to enter into relations with certain of these societies, which became designated as affiliated societies and, in time, were granted the privilege of electing one or in some cases two representatives to the council of the association. The number of the affiliated societies has grown prodigiously in recent years and amounts to something over fifty, a fact that may be taken as evidence of the success of this line of policy. The strength of the association does not depend alone upon the size of its membership, but this may be taken as an index of the extent to which it is fulfilling its purposes. Beginning with 461, the membership remained in the neighborhood of 500 until 1870, when a marked growth took place, bringing it up to 2,000 in 1885. Then followed a period of rest lasting until 1900, after which a steady and phenomenal growth occurred until now our membership is approximately 12,000. Surely in such figures we may find reason for congratulation and evidence of the wisdom of the policy laid down by the Council and ably carried out by our late permanent secretary, Dr. L. O. Howard and his successor, Dr. Burton E. Livingston.

Specialization must necessarily accompany progress. When one embarks upon a career of investigation one chooses a stream whose prospect pleases and for a time one floats placidly upon its bosom, following up its course. But soon it is joined by a large tributary and one must decide whether one will follow the right or the left branch. The decision made, one continues one's course, passing tributary after tributary, all of which, like the stream that is being followed, lead into unknown lands and at each a fresh decision must be made. In time the current strengthens, the journey becomes more arduous, difficulties are encountered, but still one keeps on, reaching farther and farther into the unknown and farther and farther from fellow searchers who have chosen other branches. One can not join them if one would, for they are ever advancing, perhaps with even greater rapidity and so one must perforce devote himself to the territory before him, hearing only by chance and at intervals rumors of the discoveries that are being made in other areas. That, it seems to me, is the experience of the investigator expressed in metaphor. The farther he and his associates advance the more they become isolated. New ideas demand new terms in which they may be discussed and so the members of each group come in time to speak a peculiar language and their isolation thus becomes more pronounced, for there is a limit to the number of languages that each of us can understand, some of us, indeed, have but a moderate command of even our native tongue.

And if this be a true statement of conditions, if it be true that even those familiar with the scientific methods find difficulty in appreciating the work of those laboring in other fields, how much more difficult must it be for those who from choice or from lack of opportunity have not had the advantage of a scientific training and yet are deeply interested in the progress and achievements of science. These form a not inconsiderable and important portion of our mem-

bership; they come to our meetings to hear something of the latest achievements of science and they listen to addresses largely in an unknown tongue. They ask for bread and are given a stone and profit little from such a monolithic repast. Yet these are the persons that we should endeavor to interest if we are truly and fully pledged to promote the advancement of science. Esoteric science may lead from discovery to discovery but until the significance of its discoveries is made intelligible to what are termed the men in the street it fails to secure popular support. The unintelligible is mysterious and mystery awakens either ridicule or dread.

Much has been spoken and written concerning the need for a popularization of science and something has been done towards its accomplishment, notably the establishment of *Science Service* so ably edited by Dr. Slosson. But is not this very thing a prime duty of this association, devoted as it is to the advancement of science, and does the association live up to the full measure of its responsibilities in this matter? I believe I am right in stating that we have not been so successful in this respect as some of the sister associations in other lands. True, we make some endeavor in providing special evening lectures that are designedly popular and I venture to suppose that the presidential addresses are expected to partake largely of that character. Nor will I be revealing any secrets of policy when I say that the council has given the matter serious consideration, and one may hope that its conjoint wisdom and experience will devise additional means to meet the difficulty. In the meantime it may seem temerarious to suggest measures looking to the betterment of the situation, but a retiring president has privileges and I feel so strongly the necessity for retaining and increasing the interest of what may be termed the lay members of the association in the aims and results of scientific research that I will venture a suggestion. Lack of understanding leads to misunderstanding, and I would beg that those who contribute papers to the sections, and especially the vice-presidents of sections, should in their deliverances bear in mind our lay members and strive for simplicity and perspicuity. Most of us are educators and we have in the meetings of this association opportunities for educating found nowhere else. Let us remember this and take advantage of our opportunities.

These ideas were suggested by the perusal of a number of addresses given by early presidents of the association. There runs through several of them an almost apologetic note, as if it seemed necessary to defend researches into the mysterious phenomena of the universe, since conclusions based on these researches tended to unsettle men's minds by undermining old long-standing beliefs. This was three generations ago and the practical applications of science were neither so frequent nor so striking as they are to-day. The Morse telegraph had been used commercially four years before the first meeting of the association, but the other remarkable applications of electrical energy that have become so much a part of our every day life were as yet undeveloped. Anesthesia had been introduced into surgical practice, but antisepsis, that was to revolutionize surgery, was as yet unknown; indeed, the causation of sepsis, together with that of putrefaction and fermentation was awaiting an explanation by the genius of Pasteur and this explanation was to lead up not only to surgical antisepsis, but to the formulation of the germ theory of disease and the wonderful achievements of modern preventive medicine. How these and other achievements in other departments of science have revolutionized the world! They are tangible evidences of the benefits that science can confer upon mankind, they are recognized as such by the man in the street and he consequently has developed an interest in science and a toleration of its votaries that his forbears of three generations did not possess. Nay, not only does he tolerate science, he encourages it by providing funds for its prosecution, by richly endowing great research laboratories and by bequeathing princely prizes as rewards for important discoveries. The distrust of seventy years ago has given way to trust and the world accepts with tranquillity the shattering of many old beliefs, providing that the necessity for their destruction is vouched for by competent scientific opinion. The theory of relativity, whether or not its full significance is understood, is swallowed without a spasm, even though it may displace the theory of gravitation from what seemed to be its unassailable position; and that the atom, supposed to be the ultimate, indivisible abstraction of human thought, is in reality a more or less complex system of electrons revolving planet-like about a central nucleus, even this idea is accepted without a tremor.

This change of attitude is undoubtedly largely due to an increased appreciation of the value of science as shown by its practical applications. This may not have been the only factor, but it is a potent one. It is impossible to consider the multitudinous and marvelous facilities that have become parts of our daily life without realizing that they are but the practical applications of scientific principles to the control or utilization of natural forces and materials, without, in other words, perceiving that it is to scientific investigation that we are indebted for these advantages. The men who have made these practical applications become known and respected, their names become household words, they are the representatives and high-priests of science and their glory is reflected upon even the most abstruse fields of scientific inves-

tigation. The attitude assumed may be expressed thus: "See what great benefits science has conferred! It promises others and therefore it is to be encouraged."

For the present we must perhaps be satisfied with this. For several centuries science was under the ban, dogma was supreme and science, which necessarily found itself in contest with this, was impious and heretical. Truth was standardized and complete and to question that accepted truth was to undermine the foundations of belief. The human mind is conservative in its reactions; habits of thought are as difficult of modification as habits of action and the change from the dogmatic to the scientific habit has been slow; indeed, it is far from complete even now. The utilitarian appeal of science has done much to emancipate it from its thraldom to dogma, but it is not yet universally recognized that the utility of science depends absolutely upon its success in discovering truth. It is only by getting at the true facts and the true principles involved in any problem that the results of science become useful. The scientist is a searcher after truth and it is for that reason that he is able to confer benefits on humanity; it is for that reason that he deserves recognition. Surely he should feel no necessity for an apology for his existence.

But the ultimate truth is elusive. When science establishes a truth that may seem at first to be ultimate it but points the way to another truth lying beyond and it is to the credit of scientific men that they are ready to admit the lack of finality in what has been accomplished, once the vista of the new truth has opened out. This attitude is not easily understood by the layman unfamiliar with the scientific method, and he is apt to imagine that a confession of lack of finality means the condemnation of the older truth as false. This is a misconception that has frequently occurred and, unfortunately, it is a misconception that scientists themselves have aided in creating, by failing to appreciate the popular view-point. In the popular mind the doctrine of evolution is so completely involved in Darwin's exposition of it that it has come to be regarded as the product of his brain. Consequently any acknowledgment that some of Darwin's views may require modification is assumed to imply that the foundations of evolution are shaken. It seems trite to repeat once more the true relation of Darwin's theory to the doctrine of evolution, but there seems to be need for its repetition. Evolution as a theory long antedates Darwin's time; Laplace, to go on farther back, found it in the history of the heavenly bodies, Lyell demonstrated it in the history of the earth, and Goethe, Saint Hilaire and Lamarck saw it in the history of terrestrial organisms. What Darwin did was to give a plausible and convincing explanation of how organic evolution might have occurred, but whether that explanation is or is not the correct one matters not so far as the doctrine of evolution is concerned; that stands unshaken even though Darwin's explanation of how it was brought about be discarded. The evidence in its favor to-day is many times stronger than it was in Darwin's time and it seems incredible that man as a reasoning animal should presume to doubt its validity; such doubts can be based only on ignorance of the evidence or on unreasoning prejudice.

True, it was Darwin who focussed the attention of the world upon the doctrine, by propounding the theory of natural selection as the causal factor in the transmutation of species. The biological world of to-day does not ascribe to that factor the importance that Darwin gave it. Its action can not be denied; it is self-evident to any observer of nature's ways who finds

> that of fifty seeds
> She often brings but one to bear.

It plays an important rôle in the suppression of the unfit rather than in the survival of the fittest, but it can act only on variations sufficiently pronounced to determine life or death. It has been shown in several cases that what seem trivial variations may, under certain conditions, lead to fatal results, but even admitting these, it is difficult to believe that many of the minute differences that distinguish species have selective value. Natural selection acts effectively in the perpetuation of species, but it does not originate them and to that extent the modern biologist may depart from Darwin's standpoint. Darwin was looking for the origin of species, the modern biologist goes a step further and is looking for the origin of variations and the mechanism of heredity problems far beyond Darwin's times. But he stands on the foundation built by Darwin, sinec the whole structure of modern philosophy rests on that foundation.

It would be interesting to sketch the story of the reception of the origin of species as revealed by the records of the association. But the date of its publication was 1859 and before there could be any extended criticism of it the members of the association found themselves face to face with the struggle for the preservation of the Union. From 1861 to 1867 the association held no meetings and by that time the first interest in the "Origin" had somewhat waned. In 1867, however, Professor Newberry in his address, while protesting against the obloquy and scorn that had been heaped on Darwin in many quarters as "peculiarly unjust and in bad taste," states his belief that the theory can not be accepted since, in his opinion, a single case of altruism would overthrow it. He overlooked the fact that individual altruistic sacri-

fice may benefit the race and it is the race not the individual that nature would perpetuate.

So careful of the type she seems
So careless of the single life.

Professor Asa Gray in 1872 was the first to express definitely in a presidential address his belief in a process of transmutation in organic life and, as was usual with him, he expresses himself so felicitously that I venture to quote his words. "Organic nature—by which I mean the system and totality of living things and their adaptation to each other and to the world—with all its apparent and, indeed, real stability, should be likened, not to the ocean, which varies only by tidal oscillations from a fixed level to which it is always returning, but rather to a river, so vast that we can neither discern its shores nor reach its sources, and whose onward flow is not less actual because too slow to be observed by ephemeræ which hover over its surface or are borne upon its bosom."

It is interesting to note that before 1859 the question of the permanency of species was already exercising the minds of members of the association. This was a reflection of the discussions on the same question that had earlier agitated the scientific world in Europe. The immutability of species predicated by the definition of the term by Linnaeus was being questioned and the idea of transmutation, later to be known as the doctrine of evolution, was in the air. This, let me repeat, was long before Darwin began to reflect upon the question during the voyage of the "Beagle," long before Wallace in the Malay archipelago began to think along the same lines as Darwin. In 1849 and again in 1850 Professor Agassiz approached the question, indicating the ideas later fully elaborated in his *Essay on Classification* according to which there was a definite plan in organic creation in which each species had its place from which there could be no departure. This position traces back to the influence of Cuvier, which is also manifest in a paper presented by Professor J. D. Dana at the meeting of 1857, in which, confronted with the variability shown by natural species and yet possessed by the idea of their essential immutability, he is driven to a position that forcibly recalls the Platonic theory of ideas or the metaphysical subtleties of scholastic realism, holding that "Species are realities in the system of nature while manifest to us only in individuals." I mention these pronouncements merely to emphasize the fact that the idea of transformationism, that is to say, the idea of evolution, was in men's minds long before the publication of the *Origin of Species*. These pre-Darwinian utterances were, it is true, in opposition to the idea of evolution, but that they should have been made is an indication that that idea was exercising men's minds.

Since evolution has become a fundamental doctrine of modern scientific philosophy it would be of interest to discuss its influence on scientific investigation. The field, is, however, too extensive to permit of adequate treatment of it as a whole and I shall, accordingly, limit my remarks to that portion of it with which I am most familiar and even then but a mere sketch is possible, so numerous and so varied have been the lines of investigation that have opened up since 1859. Unfortunately, here again the records of the association give but little assistance, since, after Professor Agassiz ceased regular attendance on the meetings, zoology for many years was but casually represented and the actual trends of zoological investigation were not clearly revealed by the papers read. But many of the new developments in zoology, its evolution, that is to say, fall within the memory of many of us older men and ample material is available by which the more recent developments may be connected up with the older viewpoints.

In the period immediately preceding Darwin the school of transcendental morphology was at its height and attention was concentrated upon finding the archetype structure, a general plan of organization which could be traced, with adaptive modifications, through the whole scale of animal life. The teachings of this school, led by Saint Hilaire in France, by Oken in Germany and by Owen in England, had a profound influence on zoological thought, especially in two directions. In the first place it divorced morphology, the science of structure, from physiology, the science of function, establishing the former as a special science whose problems were the discovery of homologous parts throughout the range of animal life. Homology was a purely structural idea, function had no place in the determination of the equivalency of parts and so, for the comparative anatomist, function ceased to be of interest.

In the second place by the predication of a structural archetype the transcendentalists opened the way to the idea of the essential unity of animal forms. If there were a primitive archetypal structure by modifications of which the various forms of animal life had been produced, there followed an implication of a definite relationship between these various forms, and the way was smoothed for the reception of the doctrine of evolution.

It is remarkable, however, how small a part comparative anatomy took in the establishment of the doctrine, although it possessed data of great pertinency and in great abundance. Darwin did, of course, make some use of these data, but he was not a comparative anatomist but rather a systematist, and the greater mass of the accumulated anatomical matter was left unapplied. Nor was there that burst of further activity that might have been expected in

comparative anatomy after the acceptance of the evolution theory. That may partly be explained by the serious blow dealt the transcendental school by Huxley in 1857 when, with keen logic and trenchant facts, he demolished the vertebrate theory of the skull, a critical and essential part of the transcendental belief. True, comparative anatomy did not languish in the post-Darwinian days; it could not with two such protagonists as Huxley and Gegenbaur, and its efforts were directed toward the substantiation and strengthening of the theory. But a more attractive field was suggested for study and to the investigation of this zoologists flocked as prospectors to a newly discovered gold-field.

The doctrine of evolution predicated a genetic relationship of forms, that is to say, each group of forms, species, genera, families or types each had a pedigree, each had behind it a long series of ancestors by the modification of which it had been developed. As far back as 1828 von Baer in his studies on the development of the chick had been struck with the resemblance which that form in its early stages showed to the embryos of other vertebrate types and expressed this fact in the law that the general characters of the great group to which an embryo belongs appear in development earlier than the special characters. Even earlier (1821) J. F. Meckel had maintained that the development of the individual organism obeys the same laws as the development of the whole animal series; that is to say, the higher animal in its gradual development passes essentially through the permanent organic stages that lie below it. These ideas in the days of the transcendental school could have little effect, though of great interest, but with the acceptance of evolution they took on a new meaning. In 1864 Fritz Müller, who had been studying the development of Crustacea while in exile in Brazil, published his results in a volume termed *Fur Darwin,* and in this expressed the idea that new species might be formed either by deviating from the parental type whilst still on their way towards that type or by passing through the various stages shown by the parents and then progressing beyond them. In the latter case "the historical development of the species will be mirrored in its developmental history." Haeckel in his *Generelle Morphologie* (1866) accepted Müller's idea, terming it the Biogenetic law which was to the effect that each organism in its individual development recapitulates more or less perfectly its ancestral history. If this law be true what an opportunity was offered by embryology for tracing the pedigrees of all sorts of animals and so to embryology the zoologists turned almost *en masse* and the construction of pedigrees, phylogenetic trees they were called, became the fashion. The development of representatives of every group of animals was eagerly studied and many an ardent genealogist concentrated his efforts on the construction of a pedigree for the vertebrates, solving the problem to his own satisfaction time and time again—but it is still unsolved.

At first, with the pedigree idea so fully in mind, the most striking features of the development of the various forms were sufficient for record, but in time the embryological became more minute, the history of the development was carried farther and farther back until the study of cell lineage came into existence in which step by step, cell division by cell division, the development of various forms was traced from the ovum until the principal organ systems were differentiated. The problem of embryology had changed; it was no longer a question of tracing more or less probable pedigrees, it was the question of the differentiation of tissues and organs of the multicellular organism from the single-celled ovum. It was no longer a search for evidence confirmatory of evolution, it was the beginning of the intensive study of the phenomena that lay behind variation and inheritance.

But in the meantime other lines of study had opened up. In the seventies and eighties of the last century attention was being directed to the remarkable phenomena that were associated with the division of cells and it was found that the process of division was in the immense majority of instances initiated and controlled by the cell nucleus. This body was found to undergo a series of extraordinary changes whereby its constituents were elaborated into a definite number of rod-like bodies termed chromosomes, each of which divided, and half the number thus formed passed into one of the daughter cells and the other half into the other, the nuclei of these cells being reconstituted from the chromosomes so distributed. The germ-cells and especially the sperm-cells proved favorable objects for such studies and their study led naturally to a study of the phenomena associated with the fertilization of the ovum. It would take too much time to recount the many interesting facts that were revealed by such studies; it will suffice for our present purpose to say that they gave very definite assurance for the belief that the chromosomes were the bearers of inheritable qualities, that it was by them that the parental characteristics were handed on to the offspring.

In 1893 there appeared a work by August Weismann, of the University of Freiburg, in which were summed up and elaborated certain doctrines that he had published earlier and which had an important influence on zoological thought. He drew a clear-cut distinction between the tissues which composed the body of an organism, the somatic cells, and the germ cells which served for the perpetuation of the species, and pointed out that there had been from the first a continuity of the germ-plasm; it passed on from gen-

eration to generation and was potentially immortal, using that term in a relative sense, whereas the somatic plasm of each generation suffered death and showed no continuity, but was formed anew from the germ-plasm in each generation. These ideas once they were pointed out seemed quite acceptable, and indeed, one might almost say, self-evident, but Weismann added a further idea in maintaining that the germ-plasm, and specific changes acquired by the cally isolated and could be affected only in the most general way by the somatic tissues. Consequently variations could arise only by modifications of the germ-plasm, and specifications acquired by the somatic tissue during the life-time of an individual could not be reproduced in the succeeding generation. Change of structure of the germ plasm was the sole source of variations and these could be perpetuated only by the action of natural selection in some of its forms. At once zoologists were divided into two camps, the Neo-Darwinians, who accepted Weismann's teachings on these matters, and the Neo-Lamarckians, who persisted in believing, as Darwin himself did, that acquired characters could be transmitted. The controversy waged long and in some cases bitterly and, indeed, is with us still.

In all these various lines of investigation zoologists were concerned almost exclusively with the structural side of the problem, the divorce of morphology and physiology which traces back to the transcendental school of comparative anatomists was still in force. In their study of cell-lineage they had seen the differentiation of form and structure appearing in the embryonic cells, but all the refinements of microscopical technique failed to yield an explanation of how and why that differentiation took place. Other methods must be applied and so, following the leadership of Roux, the method employed long before by Trembley, Réaumur and Spallanzani, the experimental method, the method of the physiologists, was revived. The developing ova were subjected to various changes of the environment, they were placed under pressure, the constitution and density of the water in which they were reared was altered, they were subjected to the action of various narcotic and other poisons, they were operated upon in various ways both in the very early and in later stages and the resulting modifications in the differentiation were noted.

Into the details of the results one can not enter now, the important point is the revival of physiological methods for the investigation of morphological problems, the re-marriage of physiology and morphology after a prolonged divorce. The old quarrel between form and function has been stayed, neither the one nor the other is antecedent and determining, but both work together; form can not be understood without a consideration of the function nor function without a full appreciation of structure. The recognition of the interplay of the two is the essential characteristic of modern zoological investigation and more and more the problems first opened up by studies of structure are being attacked along functional, experimental or physiological lines. In its early days the new method was spoken of as if it had created a new science, that of physiological morphology, but it has since become so familiar that any special designation of it is deemed unnecessary.

Once revived the method of experimentation was so prolific of results, especially in embryology and in the study of the regeneration of lost parts, that it soon became applied to the most varied lines of zoological research. One can not consider all these even sketchily, but only some of the more important ones may be mentioned. Variation and inheritance were accepted by Darwin as axiomatic forces, they were taken for granted and the theory of natural selection was built upon them as upon foundation stones. The breeding and hybridization of domestic animals and cultivated plants had of course been carried on from time immemorial, but the fundamental laws governing inheritance had not been established. Varieties were obtained by crossing different strains, but it was a hit or miss process, and if desirable varieties did occur they were preserved by a process of artificial selection. It was not until 1889 that Francis Galton attempted the formulation of a law of inheritance and that on quite general lines, but it was sufficient to arouse interest in the matter; experimental breeding was begun and soon the interest grew with the discovery of accounts published in 1866 and 1867 in an obscure periodical, of the remarkable results that had been obtained by Gregor Mendel in the gardens of the Monastery of Brünn. A study of these accounts revealed beyond peradventure the fact that the results of hybridization far from being elusive and fortuitous are governed by definite laws which it was possible to deduce from Mendel's observations. The study of inheritance was thus placed upon a scientific basis and experimental hybridization was carried on extensively by Correns and others in Germany, by Bateson and Darbishire in Great Britain and by Davenport and Castle in this country. Mendel's law was confirmed and extended and, with the discovery of the fruit-fly, *Drosophila*, as a favorable form for experimentation, the brilliant researches of Morgan and his pupils established the location of the bearers of many inheritable characteristics in the chromosomes of the germ cells and even succeeded in indicating the position of these bearers in the individual chromosomes and their relative positions in these! As a result of all these investigations we now have an insight into the *modus operandi* of heredity undreamt of by Darwin and already we have reaped

practical benefits from them in the improvements of our strains of wheat, to mention but one example. What the science of eugenics, also based on these researches, may yet do for us is unknown—it holds out great promise.

Another line of research opened up by the experimental method was the study of the determining factors in animal behavior, a study of the responses of living matter to external stimuli such as light, temperature, contact, gravitation and other environmental forces, both physical and chemical. These were essentially studies in comparative psychology and therefore strictly speaking physiological, but, with the breaking down of the old distinction between form and function, it was perceived that they were studies of the adaptation of structure to function and they were undertaken mainly by men who had been trained primarily in morphological methods. They were studies in experimental morphology, studies of the response of the animal mechanism to external influences and they revealed the fact that while in the living substance there was a mechanism (the morphological side) by which responses could be manifested and sources of energy (the physiological side) by which the mechanism might be set in action, there was necessary also "a stimulus external to the responding protoplasm in order that an adaptive or orderly result should occur." (Davenport.) The stress placed by these studies upon a mechanistic explanation of animal activities promptly aroused the opposition of those who still clung to the earlier vitalistic explanation and, as in other cases where fundamental principles are involved, the contention still goes on and will continue until increasing knowledge reveals the truth.

More recently still another line of investigation has attracted those interested primarily in questions of form and structure and in this case also the morphologist has adopted methods and ideas from sister sciences. The physiologists had demonstrated the existence in the body of special organs which manufactured substances influencing in definite ways the chemical activities of the tissues; they had shown that these so-called endocrine organs or ductless glands such as the thyroid, the pituitary and the islands of the pancreas, produced substances necessary for the normal activities of the body and that a lack of these substances resulted in definite and serious disturbances of these activities. Further they had shown that various tissues of the body produced similar substances, hormones, precipitins, secretins and lysins, each with a definite influence upon the activities of some other organ or tissue. All this was purely physiological, but morphologists were not slow to perceive that these substances could be usefully employed in the study of structural changes, and have turned to the study of growth and form as modified by them, have investigated their effects upon the processes of transformation from the larval to the adult stages in *Amphibia,* have sought in their action an explanation of the remarkable modifications in many organs associated with the phenomena of reproduction in higher animals and, quite recently, they have been employed by Dr. Guyer in studies on heredity. This use of endocrine substances in morphological research is but begun, its results may be realized in the future.

I would like to have considered some special instances in which the application of the experimental method has thrown a flood of light upon structural problems, such, for instance, as the fertilization of the ovum, the problem of sex-differentiation, in which direct observation has also played an important part, and the recent attempts of Stockard, Guyer, Detlefsen and others to throw light by refined experimental methods on the old problem of the inheritance of acquired characters, but time is lacking for their proper discussion. With regard to the last example I might add that while these experiments have failed to render a decisive answer to the problem they hold out hope that similar lines of research may at least result in the discovery of a neutral ground on which the contending camps may come together.

So with new methods the fields of investigation have broadened out and knowledge has increased by leaps and bounds. And it is with especial satisfaction that we may note that in these progressive zoological studies the scientists of this continent have always been well in the van, if not in the fore-front of the advancing column. But all through the almost overwhelming flood of new knowledge there runs the guiding clue supplied by the doctrine of evolution. That has been the stimulus and dominating idea in all these studies; without it many, very many of them would never have been conceived and knowledge would have lost thereby. No! Evolution is not dead, nor can it be killed by legislative enactment.

Let me conclude this retrospect with a message for guidance in the future, taken from one who did not always find satisfaction in the advances and applications of science, and all the more impressive on that account. It is not the first instance in which a prophet from whom curses might be expected gave blessings, real or implied, instead. The words are those of Mr. Ruskin. "Go to Nature," he says, "in all singleness of heart and walk with her laboriously and trustingly, having no other thought but how best to penetrate her meaning; and remember her instructions—rejecting nothing, selecting nothing and scorning nothing; believing all things to be right and good and rejoicing always in the truth."

J. PLAYFAIR MCMURRICH
UNIVERSITY OF TORONTO

THE ANDES IN NORTHERN PERU

MR. N. E. PEARSON has recently returned from a trip across the Western Andes of northern Peru, where he went to collect fishes. He started in June, 1923, and went direct to Lima to secure government cooperation. After making arrangements to facilitate travel he returned to Pacasmayo, a port on the northern coast of Peru. He went by rail to Chilete and then took the regular pack train route to Cajamarca, Celendin and Balsas on the Maranon. He retraced his steps to Cajamarca, from where he descended the Crisnejas valley to Tingo de Pauca, a point on the Maranon about 25 miles above Balsas. He touched the Maranon at one other point, Guayabamba, from where he returned to Pacasmayo. On the Pacific side he collected fishes from the basin of the Rio Jequetepeque from sea level to about 4,000 feet.

The crest between the Atlantic and Pacific slopes lies at an elevation of about 12,000 feet and about 75 miles from the Pacific. A valley about three miles wide with about 9,000 feet elevation lies between the divide and the next crest east, which is higher than the continental divide. The ancient Inca town, Cajamarca, lies in the valley. A small stream runs in the valley and descends to the Maranon. Going westward after crossing the second crest the road descends rapidly to Celendin at about the elevation of Cajamarca. Celendin lies in a valley without a living stream at the time of the visit. After crossing another crest east of Celendin, the road descends very rapidly to Balsas on the Maranon. There are but two breaks in the descent where there are small valleys perched on the otherwise steep slope. Collections were made in Cajamarca and at Balsas, about 3,000 feet. There were no fishes between these two places. The Maranon at Balsas is a swift stream running in a gorge and fishing was very difficult, which probably accounts for the fact that there are no native fishermen. Fishing was more successful in the Maranon at the mouth of the Crisnejas and along that stream. This portion of the Maranon seems to be above the point reached by the large lowland fishes. Only mountain climbers and Andean fishes were taken. The boundary to lowland fishes was elsewhere found to be about 3,000 feet. A few larger lowland fishes are found in the Urubamba valley up to the bridge below Machu Picchu and in the Perené, at least to La Merced at 2,500 feet.

Not all the catch has been unpacked as yet. Those of the Cajamarca valley provide one notable species. It is *Lebiasina bimaculata*, effectively used on the Pacific slopes of Peru and Ecuador as an eradicator of yellow fever mosquitoes. There is a small subfamily of Characid fishes distinguished by the presence of two series of teeth in the lower jaw. In one genus, Piabucina, the usual adipose fin of the Characidae is well developed and in Lebiasina not. Lebiasina has hitherto been taken only west of the Western Andes, *Lebiasina bimaculata* in western Ecuador and Peru, *Lebiasina multimaculata* in western Colombia in both the Atrato and the San Juan,[1] the former into the Atlantic, the latter into the Pacific.

The presence, therefore, of *Lebiasina bimaculata* on both sides of the Andes of Ecuador, but not at all in Colombia, is another indication that the faunas of Ecuador and Colombia are distinct and that either this species existed before the Andes of Peru attained their present height or that this species has crossed in one or both directions during the lifetime of the species.

Mr. Pearson's trip was made for the department of zoology of Indiana University. Part I of an account of the fishes of western South America[2] has recently been published. Part II, dealing with the fishes of Chile, is nearly ready for the press. Part III, dealing with the fishes of the Titicaca Basin, is in preparation, and the material for the fishes of the eastern slope of the Andes is collected in large part.

C. H. EIGENMANN
INDIANA UNIVERSITY

SCIENTIFIC EVENTS

NATIONAL PARKS

ESTABLISHMENT of additional national parks east of the Mississippi River is recommended in the Annual Report of the director of the National Park Service to the Secretary of the Interior, who writes as follows:

There should be a typical section of the Appalachian Range established as a national park, with its native flora and fauna, conserved and made accessible for public travel and its development undertaken by federal funds, the report states. An untouched section of the Everglades of Florida also is suggested as being of national park importance. The Mammoth Cave area in Kentucky is regarded as a remote possibility for a national park.

It is owned privately, administered under a will, the terms of which provide that upon the death of the last-named legatee it is to be sold at public auction to the

[1] The details of their distribution are given in Mem. Carnegie Museum, IX, 1922, pp. 123–125.

[2] The fresh-water fishes of Northwestern South America, including Colombia, Panama and the Pacific slopes of Ecuador and Peru. Mem. Carnegie Mus., Vol. IX, October, 1922 (issued January, 1923), pp. 1–346, plates I–XXXVIII, C. H. Eigenmann.

highest bidder. There are only two surviving legatees, both over ninety years of age, so it may be expected that this area known the world over will be disposed of before many more years pass by. Only a purchase, either by appropriation of Congress for the specific purpose, or privately, for donation to the United States, will enable the creation of this area as a national park. It is estimated that about $1,000,000 would be necessary for its acquisition. Bills have been introduced in Congress proposing its purchase at this figure, but as Congress apparently hesitates to establish a precedent by the appropriation of federal funds for the purchase of lands for national park purposes, it is doubtful whether it can be persuaded to favorably consider the acquisition of even the Mammoth Cave by this means. In my opinion, the only prospect is that when this estate is offered for sale at public auction some public-spirited organization or citizen may acquire it and donate it to the United States.

National parks, however, must continue to constitute areas containing scenery of supreme and distinctive quality, or some natural features so extraordinary or unique as to be of national interest and importance as distinguished from merely local interest. The National Park System as now constituted must not be lowered in standard, dignity and prestige by the inclusion of areas which express in less than the highest terms the particular class or kind of exhibit which they represent; distinguished examples of particular forms of world architecture, such, for instance, as the Grand Canyon of the Colorado, as exemplifying the highest accomplishment of steam erosion, or the Sequoia as presenting the highest form of accomplishment in natural tree growth, the wonderful *Sequoia gigantea*, or the Yellowstone as containing the greatest geyser basins of the world, or the rugged portions of the Lafayette National Park as exhibiting the oldest rock formation in America and the luxuriance of its deciduous forests.

NATIONAL RESEARCH FELLOWSHIPS IN PHYSICS, CHEMISTRY AND MATHEMATICS

THE Rockefeller Foundation at a recent meeting (December 5) pledged to the National Research Council the sum of $625,000 for the maintenance by it, through the five-year period July 1, 1925–June 30, 1930, of a series of national research fellowships in physics, chemistry and mathematics. In addition the International Education Board has agreed to give special financial assistance in the case of fellows appointed to work abroad.

The council is already administering, with the financial support of the foundation, a first five-year series of such fellowships in physics and chemistry, the last appointments in which will expire June 30, 1925. The marked success of this series has led to the pledge by the foundation to support a second series in which fellowships in mathematics will be included as well as fellowships in physics and chemistry.

The National Research Council is also now administering, with the financial support of the Rockefeller Foundation, a similar series of research fellowships in the biological sciences and, with the support of the Rockefeller Foundation and General Education Board, a similar series in the medical sciences. Altogether the foundation and General Education Board have pledged or appropriated a total sum of $2,000,000 to the council for the maintenance of four five-year series of national research fellowships. The council is convinced that these high grade fellowships, available for young men and women of proved research capacity as evidenced not only by graduate work of sufficient extent and character to win the doctor's degree, but to reveal unusual ability in research work, can do much for the advancement of American scientific investigation.

VERNON KELLOGG,
Permanent Secretary
NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

DINNER IN HONOR OF DR. BOHR

ON November 24, a group of Washington scientific men tendered a dinner to Dr. Niels Bohr, who has delivered a series of lectures on the atom in various cities of the United States.

According to the report in *Industrial and Engineering Chemistry*, Dr. Arthur L. Day, of the Geophysical Laboratory, acted as toastmaster, and F. C. Brown, of the Bureau of Standards, extended greetings to Dr. Bohr, who then spoke briefly on the great possibilities just ahead in the field of science due to recent discoveries, likening the present to the time of Newton which preceded great things in the scientific world.

Dr. Bohr was followed by P. D. Foote, who, to emphasize the size and great numbers of atoms, pointed out that if the molecules in a tumbler of water could all be labeled for later identification and the water were then mixed with all the water in the world, including the moisture in the atmosphere, and if after thorough mixing the tumbler were again filled, it would contain two thousand of the original molecules. Further, on the day of the dinner German paper marks were quoted at about sixty cents per trillion, and yet one paper mark would buy three billion gold atoms or sixteen thousand atoms of radium.

C. G. Abbot discussed the atomic theory as applied to the spectrum of the stars and F. G. Cottrell stressed the necessity of understanding the latest atomic and molecular theories in order to make real progress in the fixation of nitrogen, and said that the work of Dr. Bohr had set the pace. C. F. Marvin remarked that the study of the weather had not been reduced to such a fine point that atomic and molecu-

lar theories were thus far of direct applicability but it is recognized that the electrical condition of the atmosphere plays a great part and in studies of the future the theories now being developed in physics and chemistry will undoubtedly be extremely useful.

Preceding the dinner Dr. Bohr took part in a colloquium at the Bureau of Standards.

THE ENGINEERS' TESTIMONIAL DINNER TO DEAN COOLEY

Dean Mortimer E. Cooley, of the Colleges of Engineering and Architecture of the University of Michigan, was the recipient of a tribute such as come to few at the Engineers' dinner, which was given in his honor at the Hotel Statler in Detroit on November 23. It was a personal recognition, full of enthusiasm and honest sentiment, on the part of his friends, his former students and his confrères, everywhere. The speakers were:

Call to Order by Chairman, Alex Dow, M.Eng. (*Hon.*) '11, past president, Det. Eng. Soc.

Introduction of Toastmaster, Mr. Walter S. Russel, '75*e*, M.Eng. (*Hon.*) '10.

Mortimer Elwyn Cooley:

At his Boyhood Home, Robert F. Thompson, '92*l*, LL.M. '93, Judge 7th District, New York Supreme Court.

"As Cadet and Ensign," Ira N. Holis, President Worcester Polytechnic Inst., Mem. A. S. M. E.

"As professor of mechanical engineering," Ernest B. Perry, '89*e*, Mech.E. '96, Manager Industrial Works, Bay City, Michigan, Mem. A. S. M. E.

"In the service of his country," Hon. Edwin Denby, '96*l*, Secretary of the Navy, Represented by Admiral John K. Robinson, U. S. N.

"On the Yosemite," Granger Whitney, Williamsburg, Mich. Apple grower.

"As dean of engineering and architecture," Marion L. Burton, President.

"In the engineering profession," F. Paul Anderson, dean of engineering, University of Kentucky.

"In the Federated American Engineering Societies," Philip N. Moore, past president, A. I. M. & M. E., vice-president, Federated American Engineering Societies.

"As a companion," Hon. Chase S. Osborn, LL.D. (*Hon.*) '11, ex-governor of Michigan.

Dean Cooley did not speak but he held a reception after the dinner at which every one of the 550 engineers present extended their personal congratulations.

THE MEDALISTS OF THE ROYAL SOCIETY

At the anniversary meeting of the Royal Society held on November 30, the report of the council was presented and the president, Sir Charles Sherrington, delivered his address. Those to whom medals were presented and their qualifications were as follows:

Royal Medal. Professor Charles James Martin.—Professor Martin is distinguished for contributions both to physiology and to pathology. Investigating snake venoms, he differentiated two groups in virtue of their action, one nervous, the other, so to say, humoral. His work on heat-regulation in monotremes threw light on the evolution of the thermotaxis of warm-blooded animals. More recently his researches have lain in the colloidal chemistry of proteins, and in protein-metabolism. As director of the Lister Institute he has contributed to many investigations, in addition to those actually issued in his name. Thus he has been intimately associated with the inquiry into the influence of accessory food factors of diet in the prevention and remedying of "deficiency" diseases, such as scurvy and rickets, an inquiry the success of which may be regarded as one of the recent triumphs of preventive medicine.

Royal Medal. Sir William Napier Shaw.—In the great advances made during the last twenty-five years in the science of meteorology, Sir Napier Shaw has been amongst the foremost pioneers. During his twenty years' administration at the Meteorological Office, that office saw three marked steps forward: two of these were changes in its quarters; the third and greatest was the change in outlook of the work of the office, whereby it assumed, under Sir Napier Shaw's stimulating influence, the character of a scientific institution for the interpretation of meteorological phenomena. With the assistance of his scientific staff, he has developed the physical and dynamical aspects of the subject, and has done much to concentrate attention upon the thermodynamics of meteorology, wherein the motions of the water-laden air are interpreted as the action of a thermodynamic engine. His contributions to knowledge of the air and its ways have been largely responsible for changing the basis of meteorology from one of empiricism to one of science.

Copley Medal. Professor Horace Lamb.—For forty years Professor Lamb has been recognized as one of the most prominent and successful workers in applied mathematics in Great Britain. He is the foremost authority on hydrodynamics, not only in Great Britain but the world over. Professor Lamb's scientific activity, originally centering around the subject of hydrodynamics, has radiated thence into most branches of physical science and he may be regarded as the outstanding representative to-day of the school founded by Stokes, Kelvin, Clerk Maxwell and Rayleigh. In recent years he has made important contributions to seismology, the theory of tides, and other branches of geophysics. Specially perhaps should be mentioned the assistance he has given of recent years to the Aeronautical Research Committee. Mathematical questions involved in the flow of air round aircraft, in the action of propellers, and the stresses

in aeroplane structure, are of fundamental importance, but are exceedingly difficult; and here, as elsewhere, Professor Lamb's mathematical skill and power of clear exposition have proved of the highest value.

Davy Medal. Professor Herbert Brereton Baker.—Professor Baker's researches in various fields of chemical investigation, his examination of highly purified tellurium from various sources for the possible presence of higher members of the same group of elements, and the redetermination of its atomic weight, are of outstanding merit. It is, however, his remarkable researches on the influence of traces of water in modifying chemical change, whether of the nature of combination or of decomposition, which constitute perhaps his especial distinction. The results obtained by complete drying were as remarkable as they were unexpected, because they were in direct opposition to those which followed careful drying by usual methods. The bearing of Professor Baker's researches on theories of chemical change is as important as his conclusive experimental demonstrations of the phenomena themselves.

Hughes Medal. Dr. Robert Andrews Millikan.—Dr. Millikan has long been regarded as one of the most skilful experimenters in physical science. He is awarded the Hughes medal especially for his determinations of the electronic charge e and of Planck's constant h. When physicists were still ignorant of the value of the electronic charge to within 5 per cent., Dr. Millikan, by a method of the utmost ingenuity, arrived at the value $4.774 \times 10^{+10}$ E.S.U., for which he claimed an accuracy of one part in a thousand, a claim which has stood the test of time. His determination of h was not only remarkable in itself, but was of still greater value as finally vindicating the Einstein-Bohr view of the nature of the photo-electric phenomenon.

SCIENTIFIC NOTES AND NEWS

THE presidential address of Professor J. Playfair McMurrich, of the University of Toronto, given before the American Association for the Advancement of Science at Cincinnati on the evening of December 27, is printed in the present issue of SCIENCE. Subsequent numbers of the journal will contain the addresses of the vice-presidents of the association and others of the more important addresses and papers presented at the meeting. A special number will contain a full account of the proceedings.

JOHN TATLOCK has been elected president of the New York Academy of Sciences, in succession to Professor R. A. Harper. The vice-presidents for 1924 are: Carl P. Sherwin, Robert Cushman Murphy, William D. Matthew, Robert S. Woodworth.

AT the fifth annual meeting of the Chemical Industry Club of London, Sir William Pope was elected president and Professor W. R. E. Hodgkinson, vice-president.

JOSEPH BARCROFT, F.R.S., reader in physiology in the University of Cambridge, has been appointed Fullerian professor of physiology at the Royal Institution, London, in succession to Sir Arthur Keith.

DR. KONSTANTIN VON MONAKOW, professor of neurology in the University of Zürich and the author of numerous works on the normal and morbid anatomy of the brain and spinal cord, has recently celebrated his seventieth birthday.

THE degree of LL.D. is to be conferred on Dr. Simeon E. Josephi, Portland, by the University of Oregon at the commencement exercises at Eugene, in June, 1924, in recognition of his long services and to commemorate the twenty-five years he spent as dean of the medical school of that university.

DR. JACOB G. LIPMAN, of the University of New Jersey, has been appointed a member of the International Commission of Agricultural Ecology.

AT the meeting of the Washington Academy of Sciences on November 17, the following program was presented: "The Origin and Development of the Pan-Pacific Scientific Congress," by Dr. J. C. Merriam, president of the Carnegie Institution; "The Australian Meeting in 1923, the Scientific Proceedings," by Dr. T. Wayland Vaughan, of the U. S. Geological Survey; the resolutions adopted by the Congress on International Cooperation in Scientific Research, by Professor H. E. Gregory, of Yale University, director of the Bishop Museum, Honolulu.

THE following lectures have been given before the Astronomy and Physics Club of Pasadena:

November 2, "Anomalies of largely ionized substances in solution in the light of recent theories:" Dr. A. A. Noyes.

November 9, "An ether-drift experiment:" Professor E. B. Wheeler.

November 16 and 23, "The observational evidence of a velocity-restriction in space:" Dr. Gustaf Stromberg.

December 7, "Rainfall and sunspots:" Dr. Dinsmore Alter.

THE Physical Society of Pittsburgh was organized recently by 75 men interested in physics. The following officers have been elected for the coming year: Dr. L. O. Grondahl, *president*; Dr. G. E. Stebbins, *vice-president*; Dr. R. J. Piersol, *secretary-treasurer*. The society gave a dinner with Dr. Niels Bohr as guest of honor on November 28.

AMONG the lectures announced by the Carnegie In-

stitute of Technology for January are a series by Professor Harry N. Holmes, of Oberlin College, who will discuss "Colloid chemistry," "Emulsions," and "Gels" on January 9, 10 and 11; and a series by Professor Alfred Stansfield, of McGill University, between January 14 and 19 on "The electric furnace for iron and steel." Other public lecturers for whom definite dates have not yet been arranged are Dr. John R. Freeman, consulting engineer of Providence, R. I., and Dr. H. Foster Bain, director of the United States Bureau of Mines.

ON December 8, Dr. W. M. Wheeler, of the Bussey Institution, Harvard University, delivered an address at Toronto before the Royal Canadian Institute on "Social Insects."

DR. HENRY LEFFMANN spoke before the Franklin Institute of Pennsylvania on December 13, on "Hydrogen-ion concentration in relation to animal and plant growth."

DR. ALICE HAMILTON, of the Department of Industrial Diseases of the Harvard Medical School, lectured before the Boston University School of Medicine on October 19 on "What we know about industrial diseases."

DR. THEOBALD SMITH, of the Rockefeller Institute for Medical Research, gave an address on comparative pathology at the University of Edinburgh on November 27.

THE Academy of Natural Sciences of Philadelphia announces the foundation, as a trust with the Academy, of "The Joseph Leidy Memorial Fund." The terms of the trust provide for the award of a memorial bronze medal every third year in recognition of "the best publication, exploration, discovery or research in the Natural Sciences in such particular branches thereof as may be designated." The foundation, which has been established by Dr. Joseph Leidy II, nephew of Dr. Joseph Leidy, also provides for an honorarium to accompany the award.

THE Baillie Library of Chemistry, in connection with the department of chemistry of McGill University, was formally opened by a reception on Tuesday, December 11. Dr. Ruttan, the director, gave a short account of the development of the departmental library of chemistry and announced that the Baillie Library would be a continuation and development of the old departmental library, for which purpose an endowment of $25,000 had been made by the late Mr. John Baillie. The library, which already possesses thirty-nine sets of journals and periodicals, most of which are complete, was endowed in memory of George Irvine Baillie, a student in chemical engineering who was killed at the battle of Amiens in 1918. The reading room contains a portrait of Lieut. Baillie and a small, but unique, memorial window. The library will be developed as a reference library and new sets of reference journals in chemistry, as well as the missing volumes required to complete the present sets, are now being added as rapidly as possible.

THE Medical School of Western Reserve University, in Cleveland, announces the availability of a "Crile Research Fellowship" at $1,500 per annum for graduates in medicine or others who have proper qualifications and desire to pursue research work in one of the departments of the Medical School. The candidate is eligible for reappointment at $2,000 the second year. Applicants may address inquiries or brief statements as to qualifications to the committee through Professor Carl J. Wiggers.

NEIL M. JUDD, curator of American archeology in the U. S. National Museum, returned to Washington recently after seven months' exploration in New Mexico and Utah for the National Geographic Society. During the months of May to September, inclusive, Mr. Judd directed the important excavations in Pueblo Bonito, largest of the great communal dwellings in Chaco Canyon, New Mexico. This season's activities concluded the third year of the Pueblo Bonito project; it is anticipated that at least two more years will be required for the complete exploration of this prehistoric village. Following his researches in New Mexico, Mr. Judd led a small reconnaissance party into San Juan county, Utah, to explore an unknown section lying north of the Rio San Juan and east of the Colorado. The prime purpose of the expedition was to ascertain whether further exploration in this region is desirable. Inasmuch as portions of the area visited had never before been entered by white men it is not improbable that the reconnaissance will be resumed on a larger scale at some future date.

UNIVERSITY AND EDUCATIONAL NOTES

NORTHWESTERN UNIVERSITY has received a gift of three million dollars from Mrs. Montgomery Ward, to be expended in the construction of a medical center. It is to be known as the Montgomery Ward Memorial and will house the medical and dental schools and serve for medical welfare work.

SIR HEATH HARRISON, Bart., founder of the chair of organic chemistry in the University of Liverpool, has generously contributed a further sum of £2,500 towards the endowment of the chair.

ANNOUNCEMENT has been made of the appointment of two vice-presidents of the University of Chicago. These are: Professor James H. Tufts, dean of faculties, and Trevor Arnett, formerly auditor of the uni-

versity and the past five years a secretary of the General Education Board. Professor Tufts will be charged with the responsibility of the development of the enlarging educational program of the university. Mr. Arnett will perform the function of business manager upon the retirement of the present business manager, Wallace Heckman, next June.

DR. RUDOLF BENNITT, of Harvard University, has been appointed assistant professor of zoology at DePauw University. He takes the place of Dr. Walter N. Hess, who has been granted a leave of absence to accept the Johnston Scholarship in the department of zoology at the Johns Hopkins University.

DR. C. E. WEATHERBURN, of Ormond College, Melbourne, has been appointed professor of mathematics at Canterbury University College, Christchurch, New Zealand.

DISCUSSION AND CORRESPONDENCE

ON THE MODEL OF THE HELIUM ATOM

IN a recent paper[1] Kramers shows that the energy of the crossed orbit model of the helium atom in its normal state when computed on the basis of classical dynamics comes out too low, 5.5235 W (W = energy of the hydrogen atom in its normal state), while the best experimental value is 5.807 W. He concludes that classical dynamics fails in atomic systems containing more than one electron, an idea also confirmed by a theoretical investigation of the excited states of helium by Born and Heisenberg.[2] As a suitable modification of classical dynamics the assumption appears reasonable that the moving electrons of such systems, instead of acting gradually and continuously upon each other in the classical manner, interchange energy and momentum in a sudden discrete way. The nature and magnitude of these exchanges shall be found by demanding a correspondence between the discontinuous and the classical processes.

This idea when applied to the crossed orbit configuration of the helium atom leads to a model of the same general character as the classical one. The electrons each have half a quantum of moment of momentum along the normal of the invariable plane, and their motion in the meridian plane is an oscillation under the influence of the nucleus alone, with abrupt changes of momentum at the end points, the magnitude of which shall be determined from the correspondence requirement. The ionization potential of such a model was found to be 5.799 W. The most important question is whether this reasoning can be generalized and applied to other systems.

RALPH DE LAER KRONIG
COLUMBIA UNIVERSITY

[1] *Zeit. für Physik,* 13 (1923), 312.
[2] *Zeit. für Physik,* 16 (1923), 229.

PLANT LICE AND LIGHT EXPOSURE

BECAUSE the true sexes in plant lice generally make their appearance in the temperate zone in the fall, the generally accepted explanation has been that the approach of cold weather or temperature is the causal factor. Along with the decrease in temperature in the fall, there is a much more marked relative shortening of the days; and it is this relative length of day to which the insects are exposed that appears to stimulate the production of the sexes; just as Garner and Allard[1] have succeeded in making ordinary fall flowering plants blossom in summer or at any other season by the employment of a short day.

In Tennessee the normal appearance of the oviparous females of *Aphis forbesi,* the strawberry root louse, is in the month of November; but by subjecting the insects, a few days after the eggs hatched February 23, to a short day of seven and one half to eight hours, out of doors in a ventilated dark chamber, the oviparous females appeared May 7 and eggs were deposited May 22.

The method used of subjecting the plants to a short day was to place the potted strawberry plants with the lice in the dark chamber at 5 o'clock in the afternoon. The following morning the plants were removed at 9:30 and placed in the light. Garner and Allard have shown that the difference in temperature inside and outside the dark house in their experiments was negligible, as the temperature inside was but 2° or 3° F. higher than the temperature outside; hence any responses on the part of the plants could not be attributed to lower temperatures.

Having been successful in the production of the sexes by the employment of a short day, and since the fall migrants or sexuparae of various plant lice are the antecedents of the oviparous forms, it was thought possible that the migration of plant lice is also due to the relative length of daily light exposure. And such was found to be the case with several species. Males and sexuparae of *Aphis rumicis* L., *Capitophorous hippophaes* Koch. and *Aphis Sorbi* Kalt. were produced experimentally in June when the temperature is high by keeping curled dock (*Rumex crispis*), smartweed (*Polygonum sp.*) and plantain (*Plantago lanceolata*), the respective summer hosts of the above species, exposed to a short day for about seven weeks. There was also obtained some evidence, which will be published shortly, that the production of spring migrants in such forms as *Aphis Sorbi,* the destructive rosy apple aphis, where they may occur in any subsequent generation after the 3rd, is governed by the increasing length of day of the spring months. The late appearance in *A. Sorbi* of the spring migrants which may result in a destructive outbreak,

[1] *Journal of Agricultural Research,* Volume 18: 553–606.

appears to be correlated with the length of day in relation to the time of hatching of the eggs.

S. MARCOVITCH

AGRICULTURAL EXPERIMENT STATION,
KNOXVILLE, TENN.

THE SANTA BARBARA SKULL

THE news items now being carried in SCIENCE Supplement are intended, of course, not for the specialist in the field to which they relate, but for those who may wish to keep in touch with the advance of science in general. This service is highly useful and is to be commended. However, by reason of the special object of the service, it becomes the more necessary that proper safeguards be thrown around these items to insure their essential accuracy. Signed articles written by specialists are judged on their merits. But with news items, it is expected that the information given either is uncontroverted or that the fact that it is controverted will be stated.

An item of news contained in SCIENCE Supplement of November 9, 1923, under the heading of "The Santa Barbara skull," departs so widely from the ideal standard of this service that it should not be allowed to pass unnoticed. The statements in question appear to have originated in the department of physical anthropology of the United States National Museum the name of Dr. Aleš Hrdlička of that department being mentioned. In this communication there is given as an item of news a categorical pronouncement as to the age of human remains found in America, and in addition an inaccurate statement as to one particular find of human remains. The antiquity of man in America is an extremely important matter to science, and at the present time is in controversy. Under these conditions it is not proper to circulate in *Science News Service* the opinion of one man, disregarding the opinion of all others who may be concerned with the same subject.

It is said in the news item under review that "the earliest human remains so far found in America date back only about three thousand years." Who, among those most experienced in reading time records, has examined the many finds of fossil man in America and determined this three thousand year limit? It is true that Hrdlička has reviewed the occurrence of early man in America. However, Hrdlička is a physical anthropologist and not a geologist, and the time element in this case is distinctly a geologic problem. Of course, those who choose to believe that man has been in America no more than three thousand years are privileged to do so. It is not, however, their privilege to circulate such opinions as unsigned items of news in a publication of the standing of *Science News Service*. Some others who have given attention to this subject have come to the conclusion that man has been on this continent for a very long period of time.

It is also said in the communication referred to that "in 1916, near Vero, Florida, remains were found which for a time were thought to be those of a very primitive type of human remains." This statement is incorrect; for while there was, and is, much difference of opinion as to the age of the Florida fossils, whether recent or Pleistocene, there has been no difference of opinion as to their character, no one having regarded them as primitive. The Vero human remains derive their particular interest from the fact that, although apparently structurally like modern man, they are there found in association with a considerable group of extinct species, including both plants and animals.

On the question of the method of interment of the Vero fossils, opinion is likewise divided. Hrdlička has been able to see in the remains only a human burial. On the other hand, others who examined the locality, including Berry, Chamberlin, Hay, MacCurdy and Sellards, found abundant and plain evidence in the geologic conditions to show that the human remains and artifacts were carried to their resting place by the stream and were a part of, and the same age as, the formation in which they were imbedded.[1]

In the case of the Vero find, Dr. Hrdlička, in advance of an examination of either the material or the locality, arrived at the conclusion that "both finds were seemingly burials."[2] Likewise in the case of the Santa Barbara skull an intimation of a conclusion in advance of the evidence is contained in the item published, in which it is stated that "anthropological experts of the Smithsonian Institution expect that scientific investigation by men trained in bone study will prove that the age of the supposedly primitive skull found at Santa Barbara, California, has been greatly overestimated."

The writer has no information on the Santa Barbara skull; it may prove to be recent. The present communication, therefore, is not a defense of that find, but is a protest against arriving at conclusions in advance of the evidence, and particularly against the use of *Science News Service* to spread propaganda favorable to certain particular views or theories.

E. H. SELLARDS

BUREAU OF ECONOMIC GEOLOGY,
UNIVERSITY OF TEXAS

[1] "Symposium on the age and relations of the fossil human remains found at Vero, Florida." *Journal of Geology*, Vol. XXV, Nos. 1 and 4, 1917. For a list of publications relating to the Vero fossils, see *Amer. Journ. Sci.*; (4), Vol. XLVII, pp. 358–360, 1919, or Fla. State Geol. Surv., 10th An. Rpt., 1919.

[2] Personal communication to the writer, July 20, 1916.

SCIENTIFIC BOOKS

Relativity and Modern Physics. By G. D. BIRKHOFF, Cambridge, Harvard University Press, 1923. xi + 283 pp.

WHEN one reads the opening sentence of the preface, "Although great interest has been aroused by Einstein's theory of relativity, there has not been available an approach to the subject which treats it adequately but with a minimum of technical requirements," he is apt to question the statement in view of the many books which had appeared before the statement was written, but then he concludes that the author is going to give us an account of how he thought himself into the theory. And he finds that the treatment is by no means a mere rearrangement of the material in other books. In many respects there is an originality in the point of view and treatment which makes it a book worthy of very careful study.

More than half of the book deals with special relativity, and in the greater part of this the phenomena of a space-time continuum of two dimensions are considered, although the generalizations to the space-time continuum of four dimensions are adequately presented. This specialization of the problem to two dimensions makes graphical representation easy, and consequently is very helpful. However, we question the advisability of carrying it to such an extent. For, after all, the student must, sooner or later, learn to think in four dimensions.

After a brief review of mathematical physics from the classical point of view, the next three chapters are devoted to a postulational treatment of space-time continua of two dimensions. After defining the apparent time t and apparent distance x of a particle B relative to a particle A by means of light-flashes from A to B and back in times t_1 and t_2, as measured at A, he introduces the graphs in terms of cartesian coordinates t_1 t_2 and x, t. Then comes the assumption (p. 24), "If in the space-time under consideration any naturally moving particle is assumed to be at rest and the velocity of light is taken to be constant (in particular, unity), then all other naturally moving particles will appear to move with constant velocities less than that of light." One asks "What is a naturally moving particle; is this its definition?" We should prefer a statement somewhat as follows: Any straight-line on the chart of an observer A making an angle θ with the t-axis would be interpreted by A as the world-line (previously defined) of a particle whose velocity relative to A is $\tan\theta$; we call it a naturally moving particle. The assumption $\tan\theta < 1$, which follows later from another assumption, is evidently introduced here to avoid imaginaries when the equations connecting the coordinates of two charts are obtained (p. 31).

In these equations, there appears a function λ whose determination depends upon further assumptions concerning the nature of the space-time continuum, and chapters III and IV are given over largely to this question. Instead of starting with Einstein's fundamental postulate: "Natural phenomena run their course according to the same general laws with respect to coordinate systems moving relative to one another with constant velocity," which is essentially equivalent to Birkhoff's definition of an isotropic space-time (pp. 34, 49), the latter considers also what he calls "aeolotropic" space-time, from the definition of which it follows that space and time have an absolute significance. Both isotropic and aeolotropic space-times are isometric in the sense that "all portions of the space-time continuum are the same in so far as the metric relations which obtain in them are concerned" (p. 33). I believe that if the author had developed the isotropic case first and then considered the aeolotropic case, there would have been a gain in clarity. Moreover, repetitions could have been avoided, and the space thus saved devoted to added details which would help the reader. Particular attention should be called to the manner in which the expressions for the proper time are developed both in the two-dimensional and four-dimensional continua (pp. 31, 156); it emphasizes the fact that methods adopted in the former case can not be used necessarily in the latter.

After deriving in Chapter V the well-known formula for the composition of velocities in isotropic space and interpreting its significance, the author obtains by very careful physical analysis the equations of motion of a particle under the action of a force and points out the significance of the apparent mass, $m/\sqrt{1-v^2}$. Following the consideration of collision of particles, the dynamical equations of a system of particles are derived. These are used for the determination of the statistical mass of a system of particles in steady state. An interesting application is made in determining the expression for the pressure of light, when it is assumed that a beam of light is approximately a system of particles of slight mass moving with a velocity nearly unity. Another important application appears at the close of Chapter VII in the derivation of the differential equations of a perfect fluid in one-dimensional hydro-dynamics. The reader gets in this investigation and in the applications to a particle, measuring rod and clock, a valuable insight into the ideas and methods of special relativity. In the first part of this chapter the same equations are derived from a set of postulates. They serve to characterize the form of the equations, but I prefer the derivation previously referred to, as it

emphasizes the physical character of the problem. In Chapter IX the same topics for four-dimensional space-time are developed in essentially the same manner.

The development of tensor calculus is contained in Chapters VI and VIII. Although much of the treatment of the former deals with two dimensions and linear transformations, the formulas are general and the reader is so informed. Whether or not it was advisable to make these restrictions in presenting this subject depends upon the reader. After the introduction in Chapter VIII of the idea of geodesic coordnates at a point, that is, coordinates for which the first derivatives of the components g_{ij} of the metric tensor are zero at a point, there is a full and clear presentation of the particular type of geodesic coordinates introduced by Riemann in terms of which the equations of the geodesics through the particular point are linear. The author makes frequent use of these Riemannian coordinates throughout the remainder of the book. In this chapter he uses them to determine the Riemann curvature tensor, to define and explain covariant differentiation and to obtain the four fundamental identities connecting the first covariant derivative of the contracted tensor R_{ij} and the first derivative of the curvature invariant R. There is no denying the fact that the use of geodesic coordinates adds greatly to the simplification of processes involving covariant differentiation, but it would have been helpful had the general expression for covariant differentiation of a mixed tensor been written down. Also, it is to be regretted that the reader must look elsewhere for an interpretation of the geometrical significance of the Riemann tensor, either from the Riemann point of view, or in connection with the parallel displacement of a vector about a closed circuit. A further interesting and important application is made in Chapter XIII, namely, the determination of all space-time continua characterized by tensor equations which are linear and homogeneous in the differential coefficients of the second order and do not contain any higher derivatives. There are three essential types: (a) the Einstein spaces $R_{ij} = 0$; (b) the spaces for which $R = 0$ and $R_{ij} \pm 0$; (c) the spaces which can be mapped conformably upon euclidean space of four dimensions.

In the preface special attention is called to the postulational treatment of electromagnetism which appears in Chapter XII. The first postulate concerning the character of the force acting on a test charge yields a skew-symmetric tensor whose components are identified with the electric and magnetic intensities of the field. The second deals with the state of the field; the third requires the equations to hold for a state of equilibrium and the fourth that the derivatives of the intensities and the density of electricity enter linearly. The problem is to find the equations which satisfy these requirements and in addition are tensor equations with respect to the space-time continuum of special relativity. By very interesting mathematical analysis Maxwell's equations are derived. Here is a good evidence of what Einstein's requirement that the equations of physics be in tensor form means for the development of mathematical physics.

The reader is introduced to gravitation first in two dimensional space-time (Chapter IX). After a brief presentation of the Newtonian theory, Einstein's principle of equivalence is clearly defined (p. 141) and is used as the point of departure. On page 144 it is assumed "that the intrinsic equations $\int ds =$ an extremum, and $ds = 0$, respectively determine, as heretofore, the paths of naturally moving particles and light waves." To agree with the Einstein theory this must mean that a naturally moving particle is one in free space. It will be noticed that the author, like Einstein, does not assume that the paths of light are geodesics. However, in Chapter XVI, which deals with planetary motion, the deflection of light rays and the displacement of the spectral lines, as derived from the Schwarzschild form for ds^2, he takes the equation of a path of light as a limiting case of the motion of a particle. In obtaining the equations of hydrodynamics and electrodynamics for general relativity Einstein makes use of the explicit hypothesis, "With an appropriate choice of a local reference system special relativity holds for every infinitesimal four-dimensional domain or volume-element of the world." Birkhoff states its equivalent in terms of isotropic space-time (p. 145) and then proceeds to use it in connection with the equations

$$\frac{\delta T^{ia}}{\delta x^a} = 0,$$

where

$$T^{ia} = \rho \frac{dx^i}{ds} \frac{dx^a}{ds},$$

which are the equations of hydrodynamics in tensor form as shown in Chapter VII. He says that in general relativity these equations "must have the extended form

$$\frac{\delta T^{ia}}{\delta \xi^a} = 0'',$$

where ξ^a are Riemannian coordinates. This is clearly an additional assumption; it means that the local coordinate system referred to is geodesic. Einstein[1] recognizes it as an assumption. In general coordinates it means that covariant derivatives are to replace ordinary derivatives. These remarks apply

[1] "The Meaning of Relativity," p. 91.

also to the generalization of the equations of electrodynamics of special relativity. Since gravitation is necessarily a four-dimensional space-time problem, this chapter merely serves to break the ground, but in Chapter XIV the reader finds the full treatment of the problem. The author's determination of tensor equations (previously mentioned) plays in well with his development of the subject, which is essentially a combination of Einstein's treatments of gravitation in his 1916 paper and in "The Meaning of Relativity," although the author makes no reference to the latter. Chapter XV is given over to a study of the solar field. In deriving the Schwarzschild form it is shown that the usual assumption that the field is independent of the time is unnecessary; this is an important result.

There are no footnotes, but at the end of the book there is a bibliography arranged according to the chapters in which the special subjects are treated. The book is well printed, and the only criticism as to form which I have to make deals with the page headings. It seems useless to put the title of the book at the head of alternative pages, when, had this space been used for section headings, it would have served a good purpose. Also an indication of chapter and section on each pair of pages would have made cross-reference easy.

L. P. EISENHART

PRINCETON UNIVERSITY

SPECIAL ARTICLES

SOME EFFECTS OF INSULIN AND GLUCOKININ ON MAIZE SEEDLINGS

IN experiments with a genetic type of maize, which is chlorotic and apparently unable to use its carbohydrates properly, tests were made to determine the action of insulin and glucokinin on the seedlings while still dependent upon the endosperm for food. The plants were started in sand, and when the first leaves began to unroll the seedlings were transferred to individual test tubes containing 20 cubic centimeters of distilled water and known quantities of either insulin or glucokinin. Each plant was supported at the top of the tube by absorbent cotton, and the roots were protected from the light. All of the fluid in the tube was poured off and fresh solution added every 48 hours, without removing the plant from the tube or disturbing its root system. Neither nutrient solution nor iron were given the plants during the experiment. The insulin and glucokinin were prepared by Collip's methods[1, 2] from fresh beef pancreas and onion tops, respectively.

[1] *Trans. Royal Soc.*, Canada, XVI, 1922.

[2] *Jour. Biol. Chem.*, LVII, 65–78, 1923.

As insulin and glucokinin produced in general the same response in seedlings, although different dilutions of the two substances were required, it is possible to group the results. In solutions carrying from 1 per cent. to 0.005 per cent. of glucokinin (or corresponding dilutions of insulin) growth was retarded, more or less, in direct proportion to the amount of glucokinin or insulin present. This retardation was particularly evident in the higher concentrations, and was more striking in root growth than in top growth. In the stronger solutions of both insulin and glucokinin the formation of secondary roots was practiacly stopped. The growth of the primary roots and of such secondary roots as had appeared was behind that of the untreated controls growing in distilled water. The delayed growth of the tops was less evident during the first few days of insulin or glucokinin treatment, but became progressively more apparent as the experiment proceeded.

Seedlings grown in solutions of less than 0.005 per cent. glucokinin (or corresponding dilutions of insulin) showed some evidence of beneficial effects, as measured by the amount and character of root growth and the amount of top growth when compared with untreated controls. The retardation of growth by strong solutions and the beneficial effects of very dilute solutions were noted both in the series of chlorotic seedlings and in series of normal green seedlings treated with insulin or glucokinin.

A third reaction, an increase in the development of the chloroplastid pigments, was found in chlorotic plants growing in insulin and glucokinin solutions. Even when grown in strong solutions which were unfavorable to root development, chlorotic plants produced enough of the green pigments to appear distinctly green when compared with the untreated controls. A pair of chlorotic plants chosen at random, the one from an untreated series and the other from a series receiving so much insulin that the root growth was reduced to about one third normal, may serve as examples of the relative amounts of chloroplastid pigments developed. The untreated plant assayed less than 1 per cent. green pigments (chlorophylls), and the plant grown in insulin 28.7 per cent. in terms of the green pigments present in an untreated green seedling. The yellow pigments (xanthophyl and carotin) in the treated chlorotic seedling assayed almost 200 per cent. as compared with the untreated chlorotic seedling. Large numbers of seedlings of the strain of chlorotic maize used in these experiments have been grown under both field and greenhouse conditions, in connection with genetic studies, but no plant was ever found which had developed an appreciable green color.

In view of the fact that insulin and glucokinin may not be absorbed readily by the roots of plants

(Dudley[3] states that only a minute amount of the active principle of insulin passes through a collodin sac), the ends of the primary roots were cut off in one series of seedlings, so that the solutions might enter the plants directly through the vascular bundles. Seedlings treated in this fashion made better growth in the stronger solutions of insulin and glucokinin than the seedlings with uncut roots. In this connection the growth of green seedlings from which the endosperm had been removed was followed. Seedlings with the endosperm removed, when grown in distilled water under the same conditions as treated plants, showed retarded growth and produced root systems strikingly similar to those of seedlings with the endosperm intact but grown in strong insulin or glucokinin solutions. These tests collectively suggest a comparison with the effects of insulin on normal and diabetic animals. Banting and collaborators[4] have shown that it is possible to lower the blood sugar in normal animals by doses of insulin to a point where the animal dies in apparently the same condition as an animal dying from hypoglycemia following the removal of the liver. The beneficial effects of small quantities of insulin given to diabetic animals have been observed by many experimenters. It seems possible, therefore, that the retarded growth of the seedlings in strong solutions of insulin or glucokinin was produced by an action of these substances which rendered the carbohydrates of the endosperm unavailable. Since plants with cut roots made better growth in strong solutions than plants with uncut roots the experiments suggest that the retardation of growth is produced by a fraction which is easily absorbed through the uninjured root cells, and that the increased growth of plants with cut roots was dependent upon the presence of a fraction not readily absorbed by uninjured roots.

M. M. ELLIS,
W. H. EYSTER
UNIVERSITY OF MISSOURI

"VITAMIN A" DEFICIENCY IN POULTRY

THE occurrence of a destructive disease of poultry, resembling an infection in its manifestations, but thought and now known to be caused by incorrect feeding methods, was discussed in the report of the California Agricultural Experiment Station[1] for 1919–20. The opinion in regard to the etiology of the disease was based upon (1) negative results of bacteriological examinations and failure to transmit the disease to healthy fowls by inoculation, and (2) on success in controlling the disease in several flocks by increasing the amount of green food in the ration, decreasing the proportion of meat scrap and eliminating cocoanut meal.

The disease is characterized by (1) a discharge from the nostrils; (2) an ophthalmia producing a viscid secretion which glues the eyelids together, followed by the formation of a tightly adherent white film over the membrana nictitans and the accumulation of a mass of white caseous material in the conjunctival sacs; (3) the appearance of white pustule-like lesions one half to 2 mm in diameter on the mucosa of the mouth, pharynx and esophagus; and (4) in the later stages, weakness and emaciation. These symptoms have often caused the disease to be diagnosed as a form of avian diphtheria or roup by veterinarians and poultrymen. Besides the above lesions, the most prominent changes found on autopsy are pale, swollen kidneys marked by a network of very fine white lines which are urate-filled tubules.

The results of controlled feeding experiments conducted by the writer in 1920[2] suggested that the disease was caused by a deficiency of some vitamin in the ration and experiments just completed have shown this to be the case. In these experiments eleven pens of fifteen fowls each were fed a basal ration of mixed grains and meat scrap properly balanced for poultry but containing no yellow corn. No other food was given in pen I, the control. In pen II the basal ration was supplemented by a salts mixture consisting of calcium carbonate, calcium phosphate, sodium chloride, sodium sulphate and iron sulphate; in pen III by buttermilk; in pen IV by cod-liver oil; in pen V by dried yeast; in pen VI by orange juice; in pen VII by cod-liver oil and dried yeast; in pen VIII by cod-liver oil and orange juice; in pen IX by dried yeast and orange juice; in pen X by cod-liver oil, dried yeast and orange juice; and in pen XI by lawn clippings.

None of the fowls in the pens which have received cod-liver oil or lawn clippings have been affected, but the disease has occurred in all other pens, affecting 11 of the 15 fowls in pen II, which were fed buttermilk, and all the fowls in the other pens.

These studies throw light on the etiology of a serious poultry disease which the writer has previously designated as "a nutritional disease resembling roup." We feel that we are now justified in using the more definite designation "Vitamin A deficiency," for this disease, although the term "nutritional roup" might be more suitable for general use among poultrymen.

J. R. BEACH
AGRICULTURAL EXPERIMENT STATION,
UNIVERSITY OF CALIFORNIA

[3] *Biochem. Jour.*, XVII, 376–390, 1923.

[4] *Amer. Jour. Physiol.*, LXII, 162–176, 1922.

[1] Report of the California Agricultural Experiment Station, 1919–20, p. 79.

[2] Report of the California Agricultural Experiment Station, 1920–21, p. 140.

SCIENCE NEWS

THE GOTHENBERG EXPOSITION

Science Service

MANY of the mightiest strides of science through the ages are vividly illustrated in the Tercentennial Jubilee Exposition in Gothenburg which is now open and will continue through the summer. Recent inventions are sharply contrasted with objects serving similar purposes in times even as long ago as the stone age, and in some departments it is possible for the visitor to trace out a complete chain of development in scientific achievement.

Archeology has proved that the region where Gothenburg now stands was inhabited at least 5,000 years ago by the ancestors of the present Swedes. One of the most interesting exhibits at the exposition is a well-preserved skeleton of a man who lived in the Stone Age, 5,000 years ago, and who had evidently met his death on what was then the western sea shore of Sweden. With his skeleton was found a two-edged axe. This crude weapon, which was also a tool, contrasts strangely with the exhibits of modern cutlery, surgical instruments, and delicate tools which have become possible through the unusual refinement of Swedish steel.

From the Stone Age also comes an actual boat which was discovered near Gothenburg. Though made of wood, this boat has, curiously enough, been fairly well preserved through fifty centuries. One can see that it was constructed by burning out the inside of a log, which was afterwards trimmed with a flint axe. This rare relic, certainly one of the oldest marine objects in the world, is item No. 1 in the Navigation Exhibition of the fair, which, according to experts, is the most complete of its kind ever prepared. Four hundred ship models alone are on display, and every phase of navigation is illustrated, whether the propelling power is furnished by oars, sail, steam or oil. Not far away is an actual Swedish marine motor of the Diesel type said to be the largest in the world. This is a four cycle, six cylinder motor, developing 2,000 horse power. It is designed for a new Swedish motor-ship of 10,000 tons.

Up-to-date navigation under steam is represented by the well-known Swedish invention, the de Laval geared turbine engine, and by the Stal turbine engine. Another Swedish invention that has been attracting much attention at the fair is the "vapor accumulator," which is used in many steam power plants in Europe and America. The company which manufactures "accumulators" is now planning to install them on steamships which make short regular trips. Thus a ship may be run by steam, and yet have no firing done on board!

One of the most striking examples of mechanical achievement through a long succession of inventions is illustrated in the Gothenburg exhibition of lighthouses and buoys. In the days of the Vikings night beacons consisted principally of wood fires built on hilltops or conspicuous rocks at times when ships were expected to return. Then came the coal fire beacon, of which the earliest known in Sweden was built in 1202. The coal was burned in an iron basket hoisted high by means of a long lever. But Sweden had no continuously tended lighthouse until 1635. Then came a long period of steady improvement which in 1904 culminated with the first use of the automatic gas light buoy, invented by the blind Swedish inventor, Gustaf Dalen, called "the Edison of Sweden." These buoys, which guide ships into New York Harbor, and into many other important harbors of the world, can operate absolutely without attention as much as a year at a time, and have an uncanny way of lighting up automatically whenever the sky gets dark, whether the darkness is due to a storm, an eclipse, or night fall. The secret lies in the Dalen sun valve which is extremely sensitive to light. Another invention of Dr. Dalen, turned out by him after he had lost his eyesight during experiments, is the "aga" light, an electric lamp which imitates daylight.

One of the most prized exhibits at the Exposition is an actual "hot air engine," which was invented and built by John Ericsson, whose fame does not rest solely on the "U. S. S. Monitor" and the screw propeller. This is one of the features in the "Swedes in Other Lands Exhibition."

ECLIPSE EXPEDITION OF THE M'CORMICK OBSERVATORY

Science Service

PLANS have been completed whereby the U. S. S. *Capella* will carry the scientific equipment and two of the scientists of the McCormick Observatory expedition to observe the total eclipse of the sun on September 10 next. The naval vessel will leave Hampton Roads on June 28 and will have as passengers Professor L. G. Hoxton, head of the department of physics of the university, and Allan C. G. Mitchell. The *Capella* will proceed through the Panama Canal and the cruise to San Diego will take a month.

Dr. S. A. Mitchell, director of the Leander McCormick Observatory, who is in charge of the expedition, and Mrs. Mitchell, will leave the university about July 15, and traveling by rail will reach California before the naval vessel.

Permission has been received from the chief of Coast Artillery for the McCormick eclipse expedition to locate on the military reservation at Fort Rosecrans, the coast artillery station on Point Loma. The commanding officer has offered to the University of Virginia observers every assistance possible.

The location on Point Loma will be one of two occupied by the McCormick Observatory party, the other being in the neighborhood of San Diego near the edge of the shadow cast by the moon. At both stations the equipment will be practically identical and will consist of a powerful grating spectroscope with which to investigate the constitution of the heated gases in the atmosphere of the sun and to determine the heights in miles that these vapors extend above the sun's surface.

ETNA'S ERUPTION

Science Service

THE recent eruption of Etna was not of the type which sometimes causes marked variation in weather over fairly long periods, Professor W. J. Humphreys, of the U. S. Weather Bureau, stated in reply to an inquiry by Science Service. Although the volcano emitted a great quantity of ashes, some of which have recently been reported to have fallen in the Alps many hundreds of miles away, Professor Humphreys did not think enough, if any of them, had reached into the upper atmosphere to cause weather changes over a period of months.

Volcanic eruptions have sometimes done this. After the famous eruption of Krakatoa in the East Indies in 1883, the winter was unusually cold, and the cold was general throughout the world. Similarly the "year without a summer," as 1816 is known, was preceded by the great eruption of Tomboro in the East Indies. Other eruptions have had similar effects, owing to the shading of the earth from the sun's rays by the fine haze of ashes, floating in the upper atmosphere and carried all over the world.

But Etna is not primarily an explosive volcano. It generally just boils over as it did this time. The explosions are not severe as volcanic explosions go. Krakatoa's 1883 explosion was heard 2,000 miles away. Etna's eruptions are not strong enough to throw any great volume of ashes nine or ten miles above the surface, which would be necessary to get them above the highest clouds from where they might be dragged down into the general circulation of the atmosphere.

THE SUN'S HEAT

Science Service

THE radiation received from the sun was reported to have declined four per cent. below normal by Dr. C. G. Abbot, of the Smithsonian Institution, at the meeting of the National Academy of Sciences in April, with detailed returns then in only until last September.

Dr. Abbot, who at that time called attention to unusual weather conditions occurring simultaneously with this temporary loss of heat on the part of the sun without offering any theory as to the connection between them, declines to be further quoted on the matter, except to say that the observed records of the sun's performance show a deficiency of heat of about two per cent. up until about eight weeks ago. Records are not yet available beyond that time.

At the time of his announcement to the National Academy, Dr. Abbot said that as a result of the sun's variation "we are not to look for anything so simple as a general drop in temperatures all over the world. Oceans, deserts, mountains, clouds and winds make up too complex a system for such simple reactions. Profound departures of some sort from normal conditions, however, we might expect." As a result of his astrophysical studies, Dr. Abbot has also concluded that the temperature of the earth is profoundly dependent on the humidity of the air and to a less degree on the quantities of ozone and carbon dioxide which the air contains.

The hot spell from which the eastern half of the United States has been suffering is due to stagnation and "scorching" of the atmosphere similar to that of a pudding that is not stirred often enough, according to Professor W. J. Humphreys, of the U. S. Weather Bureau. The progress of areas of warm and showery, and of clear and cool weather across the country has been held up, probably by a strong area of high atmospheric pressure far out in the Atlantic ocean, he said. This has resulted in stagnant conditions, and as the sun is now pouring the maximum amount of heat available upon the northern hemisphere the air gets daily hotter and hotter.

The ice patrol off the Grand Banks of Newfoundland reported June 20 that the cold Labrador current was of small volume and weak, but neither Professor Humphreys nor Major E. H. Bowie, chief of the forecasting division of the Weather Bureau, thought that had much to do with the present hot spell. Neither did Major Bowie think there was any ascertainable relation between the wide-spread warm weather in eastern North America and the unusually cold weather in the far west and in Europe.

The facts all agreed upon seem to be that the sun has for about a year been radiating less heat than normal, and that freaky weather has been observed in widely separated parts of the world; but to this the Weather Bureau officials add the qualifying statement derived from years of experience of meteorological fickleness, "the normal state of the weather is abnormal."

ITEMS

Science Service

CONSTRUCTION of the dam across the Susquehanna River near Conowingo, Maryland, is speeding up an archeological investigation of a prehistoric Indian workshop on an island eight miles above that place. John L. Baer, of the U. S. National Museum, who for years has been seeking the solution to the mystery of curiously wrought stones found in such abundance there and elsewhere, has redoubled his efforts because the completion of the engineering project will drown the island. "Banner stones," as the specimens are called, are believed to have been ceremonial objects carried by the Indians. So far they are unknown west of the Mississippi, but in New Jersey they have been found under other Indian material which indicates that they are very old. From the shape of many of these stones, it has been suggested that they probably were intended to represent birds, butterflies, and other forms of flying life which play a prominent part in many Indian mythologies.

EVIDENCES of a vitamin which occurs in green leaves, cereals and fresh meat, and which is necessary for reproductive power in animals was presented by Dr. Katherine Scott Bishop of the University of California. Rats fed a diet which was perfectly balanced and included all other known vitamins were sterile until fed green leaves, cereals or fresh meat. Dr. E. V. McCollum, of the Johns Hopkins University, told of experiments which indicated the existence of a vitamin that affects the growth of bones.

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SCIENCE NEWS

A NEW TREATMENT FOR TUBERCULOSIS

The London Times

PROFESSOR DREYER, of the Pathological Department of the University of Oxford, recently delivered at St. Mary's Hospital a lecture on "New Principles in Bacterial Immunity," which may well prove to be the beginning of a vastly important advance in the treatment of tuberculosis and some other diseases.

It is well known that the efforts to combat tuberculosis by means of vaccines have not, hitherto, met with the success which was at one time confidently anticipated. A similar lack of success has attended the attempts made to deal with certain other organisms. Professor Dreyer, at the outset of his lecture, laid it down as a general proposition that bacteria which are "acid-fast"—that is, which "hold" an acid stain—and bacteria which are "Gram-positive" (another staining reaction), resist strongly the influence of vaccines designed to overcome them.

This "acid-fastness" has been clearly proved to reside in the fatty or waxy sheath which surrounds germs of this type, for if the bacillus is "de-fatted" or deprived of its fatty protection, it no longer retains the acid stain. It therefore occurred to various workers that the fatty sheath or envelope may, in the case of the germs administered as a vaccine, prevent the effectiveness of this vaccine by shutting in the poison of the germ itself.

Vaccination, of course, depends on giving a dose of a bacterial poison, and thus inducing the body to make a large amount of antidote to that poison. If, however, the dose of poison is enclosed in an impervious sheath it may remain ineffective. In other words, no antidote will be prepared against a poison which has not been "set free."

Professor Dreyer finally evolved a method of depriving the germs of tuberculosis of their fat, and at the same time killing them. Their poison, however, remained in their bodies. These were then injected into various animals afflicted with various forms of tuberculosis. He concludes from these experiments that they justify his view that treatment with "de-fatted" germs "brings about a definite improvement, both general and local, in animals infected with *B. tuberculosis.*"

Meanwhile, Dr. A. C. Inman, of the Brompton Hospital, began, last April, to treat two cases of human tuberculosis with the "de-fatted" antigen.

"The patients, under the care of Dr. Bosanquet, had been under observation for a long period and were both steadily getting worse. They were selected as being cases only likely to improve if some extra aid could be brought into application. Even in such active cases no local or focal reaction followed the initial inoculation, nor was there any appreciable febrile reaction.

"Encouraged by the result of the first few inoculations, it was decided to undertake the treatment of a case of acute toxic pulmonary tuberculosis in a young subject aged 21 years. Again no local, focal or general reaction followed the small initial doses of the antigen; indeed, these resulted in lowering of the temperature and some amelioration of the general condition. From the nature of the disease under consideration, patient judgment and the lapse of time will be necessary before any opinion can be expressed on the permanent value of the method of treatment. In due time, whatever be the result, a detailed account of all cases treated will be published."

Professor Dreyer added that Drs. Fildes and Western at the London Hospital were also using his "de-fatted" antigen, and had written to him as follows regarding sixty cases of tuberculosis of various types:

"Most of these cases have been under our personal observation for considerable periods up to five years, and have been selected for treatment as having shown little improvement under treatment with tuberculin B. E. (Koch). Improvement has taken place in nearly all cases and is, in our opinion, of an order which exceeds obviously that obtainable by any other form of treatment which is applicable to these conditions. We have not observed any toxic effect following on the inoculations."

Professor Dreyer dealt also with his work on some other microorganisms, including those of anthrax and typhoid.

IMPORTED DISEASES AND PRIMITIVE PEOPLES

News Bulletin of The National Geographic Society

ANNOUNCEMENT that influenza is ravaging the natives of the western coast of Alaska and has resulted in many deaths, recalls that one kind of tragedy has always followed the advance of civilization. Primitive people in out-of-the-way places, once entirely isolated from civilization, have been threatened with extermination by even such ordinarily unimportant "civilized" diseases as measles. It is not a matter of unhealthful regions, for the scenes of such tragedies often have climates bracing and upbuilding to whites and to such natives as escape the first onslaught and who develop immunity to the new diseases.

The natives of Alaska had in their habits of life a marked handicap in fighting disease. They lived—and many still live—in wooden houses partly below the ground level. These had their single doors always closed and were without windows. There was one opening in the roof out of which the smoke from a central fire was supposed to find its way. As many as 50 and 60 persons lived in the larger houses and competed for the little available oxygen amid reeking odors of rancid oil and decaying fish and fish-eggs. Sanitation was unknown; all débris and refuse to be disposed of was merely thrown a little way from the doorway.

When civilization automatically transplanted its diseases to Alaska, the field was all too fertile and the "crop" grew rankly. Tuberculosis is now continually

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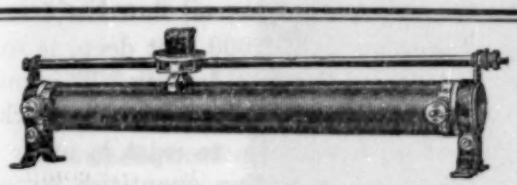

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at work killing off the native population, but the most spectacular inroads have been made by measles and smallpox, which have raged from time to time since 1842 like fires in a dry thicket. By the time an immunity at all comparable to that of the civilized world was developed, nearly half the population of many regions had been swept away. In later years the work of the United States Public Health Service has done much to raise the health standard among the natives.

Exactly the same thing happened in that paradise of isolation, the islands of the South Sea. But there the tragedy did not overtake natives weakened by unsanitary living, but rather men and women of ideal physique, living largely in the open air. Measles, smallpox and tuberculosis had never been known among them or their ancestors, and their bodies simply had no weapons for the unknown fight. The Hawaiian Islands and the Marquesas have suffered more perhaps than any of the other island groups. The tragedy still proceeds. In the Marquesas there are now about eight native deaths to one birth, and it is predicted by observers of conditions that in another decade not one full-blooded Marquesan will be alive.

SOUNDINGS ACROSS THE PACIFIC

Science Service

A LINE of soundings across the Pacific Ocean from San Francisco to Australia, taken at intervals of about five miles by the sonic depth finder, will be run this summer by the new scout cruiser *Milwaukee*, soon to leave on her "shaking down" cruise. The itinerary of the cruise is now being prepared by the Navy Department, and it is expected to include a visit to Melbourne or Sydney.

The Pan-Pacific Science Congress will meet in Melbourne from August 13 to 22, and in Sydney from August 23 to September 3. It is intended to have the results of this unique survey of the Pacific ready for presentation at the congress, following the *Milwaukee's* voyage.

Other new vessels of the navy are being equipped with the sonic depth finder and when sent out on their trial cruises will make soundings in many widely separated parts of the sea. Older vessels will be so equipped when undergoing repairs or overhauling.

Many new soundings are now being made by naval vessels equipped with the new sounding apparatus, which measures the depth by measurement of the time necessary for a sound wave to travel to the bottom and back again. Soundings may be taken while traveling at full speed. The Hydrographic office is busy recording the results of these new surveys which agree quite closely with older soundings made by line, but which owing to the rapidity with which they may be taken, are opening up many partly charted and little known regions of the sea.

OIL IN SOUTHERN VIRGINIA

Science Service

A RECENTLY discovered oil deposit is creating much interest at the U. S. Geological Survey. Oil has been struck in small quantity in the toe of southwestern Virginia, not far from the Kentucky border. Investigations to determine if the oil is present in commercial quantity are now being carried on.

The strike is about two miles east southeast of Rose Hill, Lee County, and is some hundreds of miles south of the wells of the West Virginia field. Its geological interest is in the fact that it is in the Appalachian valley where the presence of oil has been doubted by geologists, and because it is present in a geological formation—the Clinton—which is entirely overlaid by the Knox dolomite, a formation that normally lies 5,000 to 6,000 feet below the Clinton.

Oil seepage has been known in this region for several years and an experimental well was recently drilled to a depth of about 300 feet. A fair amount of oil was discovered which upon analysis was found to resemble that of the western Pennsylvania field in composition. Salt water which was found immediately under the oil has flooded the well so that the oil flow has ceased.

Drilling of another well, 2,000 feet deep, is soon to be begun near the site of the first drilling. This may determine the commercial possibilities of the new pocket. Isolated pockets of oil are known to exist in other parts of the country where oil in paying quantities is not found, and it is possible that this new find may be merely another example of such sporadic occurrence. On the other hand, it is also possible that the recent discovery may be the first indication of a new and extensive oil field in a region where no oil was supposed to exist.

ITEMS

Science Service

THE past month of June was the hottest experienced in the northeastern quarter of the United States in several decades, and one of the hottest in the 50 year record of the Weather Bureau. From the plains states to the Atlantic and from the Gulf States to the Canadian boundary the monthly reports show many records broken for the month. In many places the month was as warm as the average July. Baltimore reported the hottest June on record, Washington the hottest since 1892, when the present record was equalled. It has not been exceeded in that city since 1874.

FREE use by the public of a new water-resisting glue developed at the United States Forest Products Laboratory here has been guaranteed by the United States Patent Office. Any person may obtain the formula by applying to the government for it. No concern can patent and secure exclusive rights to the glue, which is a perfection of the casein-silicate glue developed during the war, Forest Service officials said. An improvement consisting of the addition of certain copper salts to the old formula give it better strength, water resistance, and working properties. The formula was given to a number of woodworking factories which were using it until they were stopped by threats of suit for infringement by an applicant for a private patent covering the same formula discovered by the government chemists. Upon consideration of the evidence as to priority, however, the U. S. Patent Office granted the patent to the Forest Products Laboratory for dedication to the people of the United States for their free use.

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SCIENCE NEWS

FIRE-SWEPT CITY OF ANCIENT MAN IN TENNESSEE

Science Service

CHARRED and blackened remains of a beautiful prehistoric Indian city, destroyed by fire long before the advent of the white man, but formerly covering an area of 500 acres and defended by a palisaded wall and breastworks more than a mile in length, have been discovered in two bends of the Harpeth River near Kingston Springs, Tennessee, by W. E. Myer, special archeologist of the Smithsonian Institution.

Mr. Myer, who has just returned to Washington after two and a half months' excavation at this ancient site, declared that no other old Indian town in the United States was laid out with such artistic skill as is evidenced in the structural plan of the great mounds of this large fortified place.

On one bed of the river is a great hill which was artificially shaped by the ancient builders from bottom to top. Three wide terraces were built at various levels along this hill, and its original summit was cut away until a level plaza, about 1,000 feet in length and 500 in breadth, had been formed. On this level plaza they had erected a large mound. Around the edge of the plaza and the terraces other mounds had been formed. The sun-baked clay used in the construction of ancient earth lodges was found surrounding the open plaza and along the terraces.

In addition to this great central mound on the bold terraced hill, which formed the most striking feature of the city, there were within the walls five other eminences which had also been leveled into plazas. These yielded many traces of the ancient earth lodges and other evidences of the former inhabitants. The remains of about thirty mounds of various sizes have been found. On the edge of the terraces were the earth lodges of the common people. The sacred temples and council houses and the earth lodges of the chiefs and sub-chiefs had probably been placed on the summits of ten of the largest mounds.

The upstream portion of the ancient city was defended on the water side by perpendicular cliffs of the Harpeth River. On the land side many traces still remain of the ancient breastworks, which extended for about a mile and a half and originally had wooden palisades about 10 feet in length firmly embedded in their tops. These palisades formed a wooden wall which had been plastered on the outside in order to make scaling difficult by an enemy. Along this wall at intervals of about 150 yards were found earth bastions which had formerly supported semi-circular wooden towers. The enemy advancing to attack was therefore subjected to fire from the defenders along the main wall and also an enfilading fire from the warriors in the towers on these bastions. Faint traces of the wooden towers and of the wooden palisades were found. The great length of the wall to be defended indicates that the city must have contained several thousand inhabitants.

All the buildings whose traces were uncovered appeared to have been burned. Under an overturned wall the charred remains of the woven-reed tapestry which had formerly hung on the walls of the building were discovered, and Mr. Myer and his assistants secured plaster casts of this ancient work of art for the Smithsonian Institution. No object of white man's manufacture was found on the site. Everything denoted great age.

Beyond all question this town had been lived in and destroyed long before the coming of the whites into the region, while the Indians who claimed this section of Tennessee stated to the first whites that their Indian forefathers had found these remains lying silent and deserted when they arrived.

The mention of these mysterious mounds in a rare book long since out of print gave Mr. Myer the clue which led to the exploration of the place. An airplane was used to survey and photograph the ancient Indian town site.

ALCOHOL FROM SUGAR

Science Service

GASOLINE shortage holds no terrors for the Hawaiian Islands. Their chief crop, sugar cane, is not only able to supply all the motor fuel needed locally, but also enough surplus to make a worth-while export, should the price of gasoline rise much above its present level.

The manufacture of industrial alcohol from molasses is merely awaiting the demand, according to an extensive report issued by H. P. Agee, director of the experiment station of the Hawaiian Sugar Planters' Association, and W. L. McCleery, assistant sugar technologist of the same institution.

Technical problems, they say, have been solved in a satisfactory way with respect to manufacturing both motor alcohol and stove alcohol for domestic fuel purposes. But at the average prices of gasoline and kerosene for the last five years, extensive production is not an inviting proposition.

One sugar plantation, the Maui Agricultural Company, now has in operation an industrial alcohol distillery which is supplying the needs of 32 trucks, 20 passenger cars and two tractors owned by the plantation and its employees. Five hundred stoves used in the kitchens of the field laborers are also being supplied with fuel from this distillery.

Difficulties incident to the substitution of motor alcohol for gasoline in automobiles are said to have been overcome. Much experimentation was necessary in arriving at the present satisfactory formula, but now there is essentially no difference between motor alcohol and gasoline in facility of starting or general ease of operation. The life of the motor and extent of repairs is not influenced by the new fuel. Automobiles at the Maui plantation, which have been operated with alcohol for

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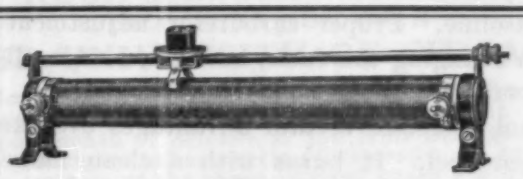

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several years, have less carbon trouble than when they used gasoline. Proper carburetor adjustment must be made in changing the fuels, however, as not all carburetors are suitable for alcohol.

Alcohol possesses certain advantages over kerosene as a kitchen fuel. It burns with a clean flame, without smoke or soot. In point of fire risk, it is more inflammable, but more readily extinguished by water. A greater volume of alcohol is required, except in so far as sooty utensils reduce the efficiency of kerosene.

Agee and McCleery estimate that it would cost, independent of the value of molasses as a raw material, about 8 to 11 cents to produce a gallon of industrial alcohol. Molasses at present is a waste by-product of the sugar cane industry. It is used somewhat as fertilizer and somewhat as stock feed, but is practically valueless. Stove alcohol costs about 25 per cent. less to make than motor alcohol. Ether as well as alcohol can be made from the molasses.

A NEW DISEASE

Science Service

A NEW disease of man, called tularemia, has been found to be present over the whole of the United States, and infections in human beings have been found from the Atlantic to the Pacific coast, according to a report by the U. S. Public Health Service.

Investigators from the U. S. Hygienic Laboratory discovered that rabbits being offered for sale in the Washington market this winter were in some cases infected with this disease, not known in the East before outside the laboratory. It has been epidemic in some western states, particularly Utah, for about five years. Tests showed that one market man was immune to the disease because of a severe attack last year. Cases were also reported from Cincinnati, Ohio, and Charlotte, N. C. Additional cases of infection are to be expected.

Since the government laboratory started to study the disease, which was first discovered as a fatal epidemic among ground-squirrels in California, six scientific workers have contracted the malady, one of them twice. Among the victims was Dr. Edward Francis, in charge of the investigations. The attacks begin with a high fever lasting about three weeks and are followed by about two months of convalescence. Although the disease has few fatalities, it causes a long period of illness that works a particular hardship on Utah farmers since it usually occurs there in midsummer.

A germ, known as Bacterium tularense, causes the disease and it is transmitted by the blood-sucking fly, the stable fly, the bedbug, the squirrel flea, the rabbit louse and the mouse louse, only the first four of which bite man. The germ can also gain access to the human bloodstream through broken skin while an infected rabbit or squirrel is being handled.

ARTIFICIAL LIGHTNING

Science Service

Two million volt artificial lightning is being created in the research laboratories of the General Electric Company at Pittsfield, Mass., in order that buildings and high-power electrical transmission lines may be protected against the powerful "electrical dynamite" that nature discharges during storms.

F. W. Peek, Jr., engineer in charge of the spectacular experiments now in progress, states that in addition to the trouble that engineers have in keeping power current from escaping from the conductors, there is the very important problem of lightning protection. A few million horsepower are released in a fraction of a millionth of a second when the lightning crashes. Electrical engineers must know how to prevent this destructive force from reaching the conductors of power lines, or they must arrange so that it will discharge harmlessly to the ground when it does get to the line.

In 1916 when the General Electric engineers built their first lightning generator it produced only 200,000 volts but now 2,000,000 volt flashes with all the characteristics of real lightning are generated at will. Wooden posts of large size are readily shattered and blown apart.

A model village for the study of lightning protection has been built in the laboratories and with controlled lightning the best methods of protecting power plants, churches and other buildings are being worked out.

The highest voltage actually used at the present time for the commercial transmission of power is 220,000 volts on a line in California, but the General Electric Company has an experimental million volt line. It is too early to say whether such high voltages will ever be required in practice. But Mr. Peek states that "a single 220,000-volt transmission line in a year can transport for 300 miles energy equivalent to 1,000,000 tons of coal, while a 1,000,000-volt line could transport for 1,000 miles energy equivalent to 25,000,000 tons of coal."

ITEMS

Science Service

THE U. S. Department of Agriculture is bringing up the heavy artillery in its fight against the cotton boll weevil. Three DeHaviland 4B planes are to be used in a few days to poison the weevils from the air by dusting the plants with calcium arsenate. Several plantations have been mapped and all arrangements made for the test which will be awaited with interest by every one connected with the cotton industry. Four applications of the poison will be made during the season, five pounds of the poison being used to the acre at each application. The chemical is sifted out of a specially designed hopper while the plane is flying at low altitudes, mostly from fifty to two hundred feet. Although extremely fatal to the weevils, there is no danger to human beings or to farm animals, in the opinion of the experimenters, from the use of the poison.

THE last representatives of a race of large-horned sheep which were once widely spread throughout Europe during the Bronze Age are found to-day on the island of Soay, one of the Hebrides west of north Scotland.

REINDEER herds started in Alaska thirty-three years ago with sixteen animals have grown until to-day there are 250,000 head of reindeer in that territory.

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SCIENCE NEWS

THE DENSEST STAR

Science Service

THE densest star in the known universe has been discovered by Professor F. C. Jordan, of the Allegheny Observatory. It is as solid as the surface rocks of the earth and as compact as the planet, Mars, or the moon. Yet it shines so brightly that Professor Jordan was able to determine that it is what astronomers call an eclipsing variable, made up of two elliptical or egg-shaped dwarf stars which whirl round and round, one of them blotting out the light of the other at regular intervals.

The newly discovered variable star, as yet designated simply as "New Variable," is not visible to the naked eye since its magnitude is about eleven, but it is in the constellation of Coma Berenices, which is located a little south of the Big Dipper.

How a star can shine so brightly and yet have a density of the most enduring earthly granite is a mystery to astronomers. "New Variable" is from 3.1 to 4.8 times as solid as water and from 2.2 to 3.4 times as dense as our sun, which is a very compactly built star itself. The average density of all the stars is only one tenth that of water. If an ordinary star were cool enough, a person might enter one, if transported there à la Jules Verne, and not realize it.

But Professor Jordan's star is nearly as solid as the earth which, taken as a whole, is 5.5 times as dense as water. It may be more compact than the moon, which is 3.3 times water's density or Mars, which rates 3.6. It exceeds in solidity Jupiter with density of 1.6 and red Saturn which is only six tenths as compact as water.

The life of the densest star of the known universe is nearly over, astronomically speaking. It is a dwarf that is nearing extinction. Stars that are in the class of eclipsing variables are as a rule more dense than either the red giants such as Antares and Betelgeuse. The variable stars average in density one eighth that of the sun, the great red giants are about one thousandth the density of air at the surface of the earth. Most of the stars are mere vapor, even our very dense sun is only 1.4 times as solid as water, and it is understandable that their material could give off light that can be seen from the earth. But the luminescence of such a solid body as "New Variable" is puzzling to account for, astronomers declare.

The distance of the densest star from the earth has not yet been determined. The density of "New Variable" was determined by computation based on the data for its period and the total duration of its eclipse. The previously known star closest in character to the new star is W Ursae Majoris in the same part of the heavens, which is 2.5 times as dense as water.

"New Variable" is also the star with the shortest period yet known, amounting to about six hours. W Ursae Majoris ranks third in short periods while SW Lacertae is second.

BORNEO ARROW POISON AS AN INSECTICIDE

Science Service

TUBA ROOT, which was used by the "Wild Men of Borneo" as an arrow poison, and is still used in the Malay States as a fish poison, is a most effective insecticide, according to experiments made at the Rothamsted Experimental Station. Experts hope that its more extended use may relieve the shortage of nicotine, which is perhaps the most perfect insecticide known. Tuba root falls short of the ideal in that it is extremely poisonous to animals, including man; hence great care has to be exercised in its use.

Nicotine is one of a very large number of poisons obtained from plants; and the head of the Ministry of Agriculture's Pathological Laboratory suggests that these may include a number of other substances suitable for use as insecticides. Nicotine is not produced in sufficient quantity to meet the demand for it and it is too expensive to be used in general agriculture except by growers of very high priced produce, such as hops.

Hence an investigation has been carried out by Messrs. Tattersfield and Roach, of the Rothamsted Experimental Station, in collaboration with Messrs. Fryer and Stenton, of the Ministry of Agriculture. Thousands of caterpillars, reared in the Ministry's Pathological Laboratory, have been tested to determine the effect on them of the various products isolated from the plants. Great care had to be exercised in rearing the caterpillars to keep them free from parasites and in good health. This is very important, otherwise it could not be decided whether a particular caterpillar died as a result of the action of the substance tested or whether it would have died from other causes had it not been treated at all.

By far the most hopeful of the plants so far investigated is Tuba Root. It contains comparatively large percentages of a series of closely related poisons which are as toxic to caterpillars as nicotine when equal weights of the two are compared.

Tuba Root seems to have been used for an insecticide first by Chinese market gardeners, who macerated the root with water and sprayed their plants with the resulting milky fluid, thereby following the lead of the natives who painted this same fluid on their arrows to poison them. The arrow poison is now used in proprietary insecticides and the demand for it on the English market is steadily increasing.

EXPLORATION OF THE COLORADO RAPIDS

Science Service

COLONEL C. H. BIRDSEYE, chief topographical engineer of the U. S. Geological Survey, will leave Washington in a few days on one of the most adventurous explorations ever undertaken by the government in peace time—a survey of the deep, narrow gorges of the Marble and Grand

SCHOOL AND SOCIETY

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A National Code for the Lighting of Schools; The New Harvard Admission Plan; Acquisition of the Greist Property by Yale University; The Failure to appoint State Superintendent Finegan; The Resignation of President Meiklejohn at Amherst.

Educational Notes and News.

Discussion:

National Organization for Educational Research: J. H. HOLST. *Intelligence Tests and Teachers' Estimates:* BENJ. B. JAMES. *An Experiment in Automatic Spelling:* HERBERT PATTERSON.

Character Education: MILTON J. BENNION.

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The Intelligence Quotients of Mentally Retarded School Children: CHARLES SCOTT BERRY. *The Retarded College Professor:* KARL J. HOLZINGER.

JULY 14, 1923

The Effect of Competency in Judges upon the Size of the Unit in Judgment Scales: S. A. COURTIS.

Antioch College: CHARLES W. ELIOT; ARTHUR E. MORGAN.

Educational Events:

Collegiate Schools of Business; At the University of Tennessee; The President of the American University of Beirut; Commissioner Graves in the Near East; The Chancellorship of Washington University; Newspaper Reports of the National Education Association Meeting; The World Conference on Education.

Educational Notes and News.

Special Correspondence:

The National Academy of Visual Instruction: DUDLEY GRANT HAYS. *The National League of Nursing Education:* LAURA R. LOGAN.

Discussion:

The Normal School Curriculum: CHARLES E. MARTZ.

Quotations:

International Education and Good Will.

A Message to Teachers: VAUGHAN MACCAUGHEY.

Conference of British and American Professors of English: RAYMOND WALTERS.

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The School and Public Health: J. HOWARD BEARD.

Pension Legislation: IDA E. HOUSMAN.

President Meiklejohn's Farewell Address.

Educational Events:

The Movement for a Federal Amendment Regulating Child Labor; Summer Sessions of Swiss Universities; The Summer School of New York University; The Guidance Study of the Cleveland Schoolmasters' Club; Educational Organization in Tennessee; The University of Arkansas and the Arkansas State Agricultural Schools; Censorship of Text-books.

Educational Notes and News.

Special Correspondence:

A Survey of the Renaissance: ERNEST H. WILKINS.

Quotations:

Liberal Education.

Educational Research and Statistics:

The Comparative Value of Certain Measures for Predicting Grades in College Physics: JAMES VAUGHN.

JULY 21, 1923

What should be the Minimum Essentials of a Four-Year Curriculum for Teachers Colleges? CHARLES H. JUDD.

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Freedom of Expression in the University: FRANK J. GOODNOW.

Commencement Address for Swarthmore College, 1923: F. P. KEPPEL.

Educational Events:

Fifty Years of Education in Scotland; A Message from the Educators of Germany; The Financial Situation of the Boston Public Library; Intelligence Tests in Civil Service Examinations; Public Education in the South; The American Home Economics Association; Courses in Education at the Harvard Summer School; The Business Side of the National Education Association.

Educational Notes and News.

Discussion:

Elimination of the Unfit; a Problem of Waste in Public Education: G. C. CAST.

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Juvenile Unemployment Centers.

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Four of the specially constructed boats will be used, manned by the most skillful boatmen to be obtained in that section, all experienced in shooting rapids. The rapids in this section of the river form some of the wildest water in the United States and each member of the party has been selected for his fearlessness in the face of danger as well as for his ability as a scientist.

Part of the work will consist of locating available dam sites in view of the proposed commercialization of the Colorado.

THE PROTECTION OF ENGINE CREWS IN TUNNELS

THE engine crews who drive the modern monster types of locomotive through the longer tunnels of American railways are frequently exposed to the presence of deadly carbon monoxide gas and to withering temperatures ranging up to 136° F., states the Department of the Interior, as the result of an investigation conducted by the Bureau of Mines in railroad tunnels in Utah and Wyoming. Hot exhaust gases are the source of danger from exposure to tunnel atmospheres. Many serious accidents have occurred in these tunnels due to asphyxiation or exhaustion of the locomotive crews, caused by exposure to atmospheres containing carbon monoxide, or to atmospheres of a high temperature and saturated with moisture. These hazards are accentuated by a group of less importance consisting of sulphur dioxide, hydrogen sulphide, soot and steam, accompanied by the decreased oxygen content of the air.

The Interior Department recommends the use of smoke deflectors on locomotives operating in tunnel districts as a means of reducing the hazard due to high temperatures, and the use of the train air-brake line as a source of air for breathing purposes for members of engine crews.

The object of the Interior Department's investigation, conducted by the Bureau of Mines in cooperation with the Union Pacific Railroad, was to determine the cause of gassing accidents by examining into composition of the air in locomotive cabs while passing through railroad tunnels; to learn the effect of these conditions on the engine crew; and to provide a means of protection for the men so exposed.

Gas samples and temperature readings taken in the cabs of locomotives were used in studying the atmospheric conditions to which the locomotive crews were exposed. The symptoms and the physiological effects produced in men exposed to the atmospheres encountered were studied. The pulse rates and body temperatures were taken, and determinations of the carbon monoxide content of the blood were made. Various methods for the prevention of gassing and for the protection of men therefrom were considered and tested, among which were the use of mechanical devices for deflecting the smoke away from the engine cab, and the use of various types of gas masks and breathing apparatus.

Of forty trips conducted in cabs of locomotives while the trains were passing through tunnels, carbon monoxide was found to be present on thirty-four trips. The operation of twenty-four trains of approximately 2,000 tons each, in a normal running time of six minutes through the Aspen tunnel in Wyoming, showed cab temperatures of 114° F. (dry bulb), 111° (wet bulb), and a relative humidity of 90 per cent. The maximum dry-bulb temperature recorded on any of the forty tests conducted was 136°, while the maximum wet-bulb temperature was 124°. The time consumed in the passage of the trains varied from 4½ to 25 minutes.

Results of physiological tests over periods of 10 minutes showed that the conditions in the cabs might be severe enough to cause asphyxiation or exhaustion in periods of 20 minutes, especially in cases where the engine is stalled.

ITEMS

Science Service

A NEW process in metallurgy said to hold promise of improved methods in the treatment of oxidized and semi-oxidized or "carbonate" ores of copper, lead and silver has been developed through the joint work of the Bureau of Mines and the University of Utah. It is known as the "chloride volatilization process of ore treatment." It depends upon the volatilization of compounds of the metals with chlorine, effected by adding salt or calcium chloride to the prepared ore. The exact chemical reactions are not known and the work is still in the experimental stage although promising great savings in the cases indicated where technical difficulties have heretofore caused much loss.

CHILDREN may suffer from the dietary sins of their parents, Professor A. H. Byfield, of the University of Iowa School of Medicine, told members of the American Medical Association at San Francisco. He described a series of animal experiments in which it was possible to produce rickets, which is due to faulty nutrition, only in the second generation of the animals experimented on. Studies of social conditions lead to the belief that causes extending over more than one generation are necessary for the production of this disease, and indicate a definite method of prevention, he said.

THE windmills that once dotted the Belgian landscape and furnished motive power for innumerable operations on Flanders farms are slowly being replaced by more efficient power machinery.

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SCIENCE NEWS

THE CALIFORNIA EARTHQUAKE

Science Service

To scientists in Washington the earthquake that shook southern California on the night of July 14 was not unexpected.

Because of the faults in the earth's crust near San Bernardino, Dr. Arthur L. Day, chairman of the advisory committee in seismology of the Carnegie Institution of Washington, stated that that region was known to have acquired strains in its crust that needed the sort of relief that an earthquake provides.

The famous San Andreas rift, which extends for six hundred miles through the Coast Ranges of California, runs about five miles northeast of San Bernardino. This same slipping plane runs through San Francisco and it is along this fault that the great quake of 1906 occurred. That famous earth movement covered a stretch of about 150 miles with San Francisco in the middle.

"South of that stretch for about 300 miles there has been no movement since 1857 when there was a severe shock, the mark of which may be traced across the desert plains like an irrigation ditch," Professor Bailey Willis, California earthquake expert, who is now returning to America after making a study of the Chile earthquake of last year, said in a Science Service statement in January last. Still further south there have been several recent shocks, but none of great violence. In the same statement Professor Willis said that "there is evidence of considerable activity in the section east and south of Los Angeles." This corresponds to the region that has just suffered a shock.

The map of California earthquake conditions soon to be published by the Seismological Society of America shows another active fault in the earth's crust just southwest of San Bernardino.

The Coast and Geodetic Survey is making precise maps of California which will aid in the prediction of these natural occurrences, but their surveys have been confined so far to the northern part of the state. Scientists connected with the Carnegie Institution, Stanford University and other institutions are also working on the problem.

Other shocks in the same area are to be expected, according to Professor W. J. Humphreys, seismologic expert of the U. S. Weather Bureau, although they will probably not be so violent as the first shock. A series of slight disturbances following the initial quake is the general rule.

A NEW MINOR PLANET

Science Service

A NEW member of the solar system, an asteroid, has been discovered by Professor George H. Peters, of the U. S. Naval Observatory. He occasionally finds such small planets on his photographic plates as a by-product of his regular observations. But the one that Professor Peters has just announced is extraordinary in that it is very close to Edburga 413, an asteroid previously known and whose return to visibility was predicted by computations. Both Edburga and the newcomer are about the same magnitude, a little more than 12, and have approximately similar apparent motions. Only the telescope can detect them; they are found by their motions in the sky with respect to the fixed stars.

"I am not quite sure of the identifications," Professor Peters stated. Only additional observations over a considerable period will settle the question of which is which on account of the similarity of motion and brightness. One of them is Edburga; the other can not be found listed in any of the catalogues and Professor Peters believes it to be a part of the heavens previously uncharted.

The coincidence of two minor planets so alike and so near each other he characterized as very remarkable. For twenty years he has been observing and discovering asteroids and this is the first case of apparent duplicity that he has discovered.

The discovery was made on the photographic plates of the heavens that Professor Peters takes with the 10-inch refractor telescope of the Naval Observatory.

In December, Professor Peters found another tiny planet that had been "lost" for fifty years. Its name was Aethra 132 and it was last seen in 1873 by its discoverer, Professor J. C. Watson, of the University of Michigan.

The Indians that once roamed the city of Washington were remembered by Professor Peters when he named an asteroid discovered by him on November 21, 1921, with the old tribal name of Anacostia. The new planet just discovered is still too young to be named, Professor Peters believes.

Both of these asteroids now under observation by Professor Peters are believed to be about twenty-five miles in diameter and they shine by reflected light similarly to the larger members of the planet family. They are twirling around the sun in orbits that lie between Mars and Jupiter.

HEALTH RECORD FOR 1923

Science Service

THE general health record during the first half of 1923 was more than satisfactory, Dr. Louis I. Dublin, statistician of the Metropolitan Life Insurance Company, reports. Following a most unpromising beginning, chargeable wholly to the influenza outbreak of the early months of the year, a consistent improvement has since been in evidence. At the end of the half year, the death rate of the millions of white policy holders of the Metropolitan Life Insurance Company was only one third of one per cent. in excess of that for the corresponding period of 1922. For the colored policy holders, the increase was 4.2 per cent. These small differences are very encouraging, coming as they have in the face of high influenza-pneumonia mortality during the first three months. The

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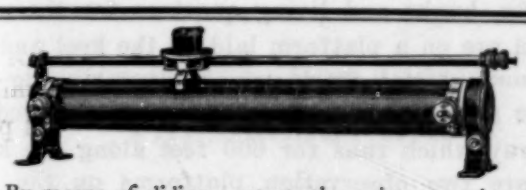

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excellent health record of the second quarter has almost wiped out the adverse margins that were in evidence three months ago.

"The best feature of the health record of 1923, to date, is the continued improvement in the tuberculosis death rate. Almost beyond peradventure, a new minimum will be recorded this year in the mortality from tuberculous disease. The continuous decline (except for a single year) that has been observed since 1911 is still going on.

"Another encouraging item of the 1923 health record is a decline in the mortality from cancer. This has been considerable among the white policy holders and there has been a slight drop among the colored."

The mortality from diseases incidental to pregnancy and child birth has shown pronounced improvement, and if the present favorable record is maintained throughout the year, the death rate for these diseases will be lower than for any year since 1917.

Two of the four principal communicable diseases of children—diphtheria and scarlet fever—registered lower death rates than for the first half of last year, according to Dr. Dublin's figures. The drop in the diphtheria rate was considerable and unless there are very unfavorable developments later in the year, the 1923 mortality from this disease will be the lowest ever recorded among Metropolitan Industrial policy holders. Measles and whooping cough, particularly the former, are causing many more deaths than during the first half of 1922. The measles rate has more than doubled among white policy holders and among the colored it was almost six times as high as for the first half of last year. An unusual item in this year's record is the very high measles death rate among colored policy holders. Ordinarily, mortality from this disease among colored children is less than that for white children; but this year the difference is very small.

The record of the half-year for accidental deaths compares unfavorably with the figures for the corresponding periods of 1922 and 1921. Substantial increases are in evidence for both white and colored persons. Automobile fatalities have increased materially.

A HELIUM AIRSHIP

Science Service

ZR-1, the all-American giant helium airship now ninety-nine per cent. complete, will be launched at Lakehurst, N. J., in August and used to test the commercial practicability of big lighter-than-air craft in this country, according to Rear Admiral W. A. Moffett, chief of the U. S. Navy's Bureau of Aeronautics. On August 1 about three weeks of exhaustive structural testing of this leviathan of the skies will be begun inside the hangar, after which a series of actual flight tests of progressively greater length will be undertaken preparatory to an air voyage to the North Pole early next year.

The helium to be used as the lifting power for the big dirigible is already on hand, and preparations for the official launching are rapidly going forward. Mrs. Edwin Denby, wife of the secretary of the navy, will christen the new ship.

Every precaution is being taken to insure the maximum possible safety and efficiency of the ZR-1 and accurate cost records of its flights under various loads are to be made with a view to determining the commercial possibilities of this type of aircraft.

The navy may in this way be able to aid in the establishment of a new method of air travel. The military use of the big airship will be as a scout for operation with the service battleship fleet.

The ZR-1 is 680 feet long, 79 feet high, and has twenty gas cells with a total capacity of 2,115,000 cubic feet of gas and a gross lifting power, with helium, of 120,000 pounds. The cruising range is 4,000 miles. Its six 300 horsepower engines can drive it at a maximum speed of 75 miles an hour or 65 miles an hour cruising speed. These six engines are located in six power cars, four of which are located amidship; two on each side of the car. One is in the midline aft, and one is located in the control car in the forward part of the ship.

In this control car are located the rudder control and other instruments used in navigating the ship, while a telephone system connects it with the other cars and parts of the ship.

The mess, bunks and living quarters for the crew of thirty men are on a platform laid on the keel and inside the duralumin metal frame which gives rigidity to the ship. The gasoline storage tanks are also located along the walkway which runs for 600 feet along the keel.

There are two observation platforms on the top of the ship, access to which is by means of ladders and hatchways running up through the center of the ship. In the bow is a mooring device with cable by which the giant dirigible can be moored to a mast.

The framework is of duralumin metal, the twenty cells for the lifting gas are made of goldbeaters' skins, while the outer envelope of the airship is made of cotton fabric doped with a special preparation to resist weathering.

The hangar which now houses the ZR-1 at Lakehurst is so large that the U. S. Capitol could be placed entirely inside with the exception of eighty feet of the dome which would project above the roof.

ITEMS

Science Service

A NEW sweet cherry which ripens from a week to ten days earlier than any cherry now grown has been evolved at the New York Agricultural Experiment Station.

BY reclamation and the planting of pine in the southern part of the west coast of France, the French government has in seventy-five years converted an unhealthy waste of sand and swamp into a health resort visited by 200,000 people a year.

PLANS for the development of the French telephone service, involving an expenditure for new equipment of 200,000,000 francs a year for ten years, are under consideration by the French government.

AN epidemic OF influenza among Eskimos in the Cape York district of northwest Greenland last year caused such a heavy mortality that it is now impossible to start an exploring expedition from that base.

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SCIENCE NEWS

ARTIFICIAL FAT FOR DIABETES

Science Service

THE invention of a new form of artificial fat that can be digested by diabetic patients was announced on August 3 by Dr. Max Kahn at a meeting of the medical staff of the Beth Israel Hospital, New York.

At that hospital feeding with the new fat has given relief in thirty cases of acidosis due to diabetes. One man was carried into the hospital for the purpose of having his leg amputated since it was attacked with gangrene. But after the artificial fat had been added to his diet the acidosis was stopped, the sores healed up and four weeks later the man walked out of the hospital on his own two legs.

Dr. Kahn, who has charge of biological chemistry in the College of Physicians and Surgeons of Columbia University and of diseases of metabolism at the Beth Israel Hospital, has been working for a year and a half to make a fat that would not break down into acid products as do natural fats in cases of diabetes. From recent researches in the chemistry of nutrition he came to the conclusion that a fat with an odd number of carbon atoms would serve the purpose. But such a fat could not be found in nature so it had to be made to order.

The investigations to simplify the method of manufacture and the carrying through of the design of the plant apparatus and installation of equipment have been conducted by Professor Ralph H. McKee, professor of chemical engineering, Columbia University, in his private laboratory, and required the services of two assistants for six months. It was through this investigation that the process has been simplified so that instead of material costing $300 or even $100 a pound, it can now be made in a factory and sold for $8 a pound, and probably this cost will decrease still more once production is well under way. A pound will last a patient from a week to three weeks.

A manufacturing plant has been built in Long Island City, and last week 200 pounds of the new product was turned out. It has been named "intarvin," meaning "intermediate fat," because the molecule contains 17 carbon atoms and is therefore intermediate in composition between the ordinary fats carrying 16 and 18 carbon atoms.

Intarvin is a white crumby substance, tasting something like tallow, but is not so soft. It is either eaten straight or mixed with a little tasteless mineral oil or made up into a mayonnaise or shaken up with buttermilk or baked in gluten bread. The diabetic patients find the new fat quite eatable and it satisfies the craving for fat common in the disease.

It is a curious coincidence that within the year 1922 two remedies, insulin and intarvin, have been invented for diabetes, which, though one of the most common and serious of diseases, has hitherto baffled medical skill. Insulin, which was discovered by Dr. F. G. Banting, of Toronto University, is an extract of animal pancreas which when injected into the veins restores temporarily the power to assimilate sugar. Intarvin is a synthetic fat which is assimilable by diabetics in whom natural fats produce an excess of acid. Neither insulin nor intarvin is regarded at present as a permanent cure for diabetes, but both restore temporarily the digestive powers, the former for sugars, the latter for fats, but each increases somewhat the ability to handle the other type of food.

GLUCOKININ AS A SUBSTITUTE FOR INSULIN

Science Service

DISCOVERY of "glucokinin," derived from plants and appearing to have the properties of insulin, is described by J. J. Willaman, associate professor of biochemistry in the University of Minnesota, in a statement made public by the American Chemical Society.

Recent discoveries in this field establish one more profound relationship between plants and animals, says Professor Willaman, who reports successful use of glucokinin on diabetic dogs and rabbits. Clinical tests as yet have not been made on human beings.

Things are changing fast in the diabetic world, continues Professor Willaman. It was just a year ago that a group of scientists at the University of Toronto announced that they had prepared an extract of pancreas which, when injected into dogs, would cause a lowering of the sugar content of the blood.

Since then the extract has been used successfully in the case of human diabetes at several clinics, and has been manufactured commercially. Now the announcement is made that the active principle has been demonstrated in plant tissue, including lettuce, bean leaves and the onion.

Dr. J. B. Collip, formerly one of the Toronto University group who first made insulin, and now at the University of Alberta, conceived the idea that, since injection of "insulin" enables the animal to burn sugar and store up glycogen, those plants and lower animals which contain glycogen might also contain this active principle.

Glycogen is "animal starch," and is abundant in clams, oysters, yeast and mushrooms. He tried clam tissue, and had no trouble whatever in preparing an extract which helped rabbits and dogs to burn sugar. Yeast, however, proved a stumbling block. He tried over twenty different methods before he found one that would produce an active extract. After that he could prepare very active materials at will.

Next he tried green leaves of lettuce and wheat, and then the bulb of an onion. In all cases he demonstrated the presence of a substance which apparently had all the properties of "insulin." He doesn't give it the latter name, however, but prefers to call it "glucokinin."

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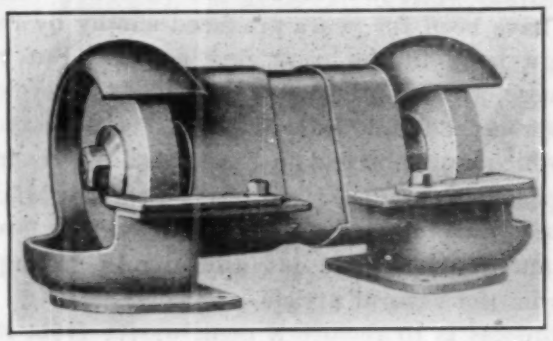

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LIGHT TESTS TO DETECT CULTIVATED PEARLS

Science Service

DR. FRED E. WRIGHT, of the Geophysical Laboratory of the Carnegie Institution of Washington, has thrown light, literally, on natural pearls and cultivated pearls, and now they can be told apart.

There are now three kinds of genuine pearls. Most valuable are the "natural" or "normal" pearls found by divers the world over. "Blisters" or baroque pearls, not nearly so beautiful or expensive as the "natural" article, have been for years produced simply by inserting a foreign body in the producing oyster. But recently a Japanese, Dr. K. Mikimoto, succeeded in developing a patented method for inducing pearl oysters to grow pearls which are spherical in shape and similar in external appearance to fine "natural" pearls. Mikimoto's cultivated pearls are now on the market, and pearl merchants and jewelers have had difficulty in distinguishing them from the natural article.

His process is to remove a pearl oyster from its shell, cut a patch off its outer, shell-secreting mantle large enough to enclose, as a sac tied at the neck, a bead of mother-of-pearl or even an inferior pearl. This bead is imbedded in another live oyster, which, after proper treatment of the wound, is returned to its native habitat where in the course of a few years a coating of pearl may be deposited around the inserted bead.

Dr. Wright's methods for detecting the presence of such a bead of mother-of-pearl depends on the fact that the layers of the natural pearl and the mother-of-pearl nucleus reflect light differently. One method of finding the cultivated pearl, he explained, is to stand with your back to the window, sun or other strong source of light, and hold the pearl so that it is illuminated by the light. When the pearl is rotated on a string, the characteristic sheen of the mother-of-pearl can be clearly seen shining out from inside the pearl when the pearl is in certain positions.

Another method of distinguishing the fine pearl from the cultivated one consists in placing it on a thin sheet of metal directly over a small hole drilled through the metal. The hole serves as an opening through which a beam of strong light passes. The only light that reaches the observer comes through the pearl and shows the shadow of any foreign nucleus which may be in the pearl.

When a small real pearl is used as the center of a larger cultivated pearl, this nucleus can be discovered by an examination of the hole drilled through the pearl for stringing it. A boundary between the nucleus and the outer pearl substance is seen with the aid of a tiny mirror and a microscope. The mirror is made by holding the end of a fine gold wire in a Bunsen flame for a time sufficient to melt down the tip and form a small bead, which presents a smooth and excellent reflecting surface. This wire with the tiny mirror on the end is inserted into the hole in the pearl which is illuminated by a strong light from the side and the reflections from the bead are observed through a low power microscope.

THE ORIGIN OF ANTHRACITE

Science Service

INVENTION of a method for the determination of the structure of anthracite coal and incidentally for the positive identification of coal seams has been announced by H. G. Turner, assistant professor of geology at Lehigh University. The method makes certain for the first time the vegetable origin of anthracite coal.

Although geologists have been fairly sure that hard coal was formed like soft coal from plants which grew in remote geologic ages there was no direct confirmation of their surmises until Professor Turner announced his invention. Soft coal had been sliced into minute sections thin enough for light to pass through and had been subjected to a microscopic examination which showed definitely its vegetable origin, but this method had been impossible for use with anthracite because no matter how thin it was cut it was still absolutely opaque.

Professor Turner found that by first giving the surface of the coal a fine polish, then drying it thoroughly at a temperature somewhat less than red heat, and then heating the polished surface in the flame of the blowpipe or Bunsen burner to a dull red heat for a few minutes it was possible to see through a microscope the structural details of the coal. The final heating burned away some of the coal, leaving a sort of skeletonized surface or etching. This was then observed through the microscope by a beam of light reflected from it, showing with great fidelity the structural details.

Photographs have been taken which show absolutely the vegetable origin of the coal. Some pieces resemble fragments of modern woods such as the maple or pine, while others show a pithy structure like bamboo or weeds, but unlike most of the trees of the present day. Spores of the great tree ferns of the far away days when the coal beds were being formed have also been found.

An interesting part of the discovery lies in the fact that in most of the samples there has been no deformation of the cell structure such as would be caused by great pressure. Geologists have thought that hard coal was formed by the heating of soft coal under pressure. Professor Turner's results do not confirm this theory in so far as pressure is concerned. There is evidence that the coal has been heated, but none that it has been compressed.

A practical application of Professor Turner's invention is expected to be in the new means for identification of different coal beds. Operators lease particular beds for mining, and it sometimes happens that through twisting, breaking or pushing up or down of strata, there is much doubt and confusion as to just which bed belongs to which company. Professor Turner has found that the coal from different beds has marked differences of structure, having been formed from plants which while of the same geologic epoch grew perhaps at intervals of thousands of years, during which the earlier beds were covered with deposits of rock. In case of doubt as to ownership all that will now be necessary will be to subject the coal to microscopic examination.

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SCIENCE NEWS

PITHECANTHROPUS ERECTUS

Science Service

AFTER thirty years denial to his fellow scientists from all nations, Dr. Eugene Dubois, discoverer of this "missing link" in human evolution, has accorded to the American School for Prehistoric Studies in Europe, under the direction of Dr. Aleš Hrdlička, of the Smithsonian Institution, the courtesy of the first opportunity to make a thorough examination of the original fossils. On their return to Amsterdam on July 16 after an inspection of the original bones at Dr. Dubois's home at Haarlem, the American scientists seemed convinced that this ape-man was more nearly human than formerly believed.

"The examination was in many respects a revelation," according to Dr. Hrdlička. "When Dr. Dubois publishes his detailed study, which he tells me he expects to do before the end of the year, *Pithecanthropus erectus* will assume an even weightier place in science than it has held up to now. None of the published illustrations or the casts now in various institutions is accurate. Especially is this true of the teeth and thigh bone. The new braincast is very close to human. The femur is without question human."

The remains consist of the now for the first time thoroughly cleansed skull-cap, the femur, three teeth, two molars and one premolar. Besides these, there is a piece of a strange primitive lower jaw, a later, but nevertheless still primitive, type of man found in lime deposits in a different part of the island from that of the other bones.

Dr. Hrdlička stated that the original relics are even more important than held hitherto. He predicted that though all controversial points may not be settled, the specimens will assume even a weightier place in science than they have had up to the present.

Dr. Dubois found these ape-man remains near Trinil in the island of Java in 1891, but since then has steadfastly refused to allow other scientists to examine the originals thoroughly, so that they have had to content themselves with the casts and illustrations which Dr. Hrdlička now declares to be inaccurate.

Dr. Dubois demonstrated personally and without reserve the precious specimens which have been withheld from other scientists for over a quarter of a century. The cordial invitation for the Americans to see the originals was transmitted through Dr. Arthur Smith-Woodward, of the British Museum of Natural History, and given to Dr. Hrdlička when he arrived in Europe last month.

Dr. Hrdlička wrote in a report of the Smithsonian Institution several years ago as follows: "On account of peculiar circumstances an attempt to describe first hand the important specimens of Pithecanthropus meets with serious difficulties. It would surely seem proper and desirable that specimens of such value to science should be freely accessible to well-qualified investigators and that accurate casts be made available to scientific institutions. Regrettably, however, all that has thus far been furnished to the scientific world is a cast of the skull cap, the commercial replicas of which yield measurements different from those reported taken of the original, and several not thoroughly satisfactory illustrations; no reproductions can be had of the femur and the teeth, and not only the study but even a view of the originals, which are still in the care of their discoverer, are denied to scientific men."

CALIFORNIA'S WATER POWER

Science Service

"CALIFORNIA'S mountain streams made possible last year the delivery of energy equivalent to a day's work by 4,300,000,000 people, or two and a half times the entire population of the world to-day," Robert Sibley, consulting engineer of this city, said in a report made to the American Society of Mechanical Engineers, in which he described present day water power developments in this state and predicted a still greater future. In making his estimate of the amount of power already harnessed by a network of six California power plants, he assumed that the daily work of a human being is equal to one kilowatt-hour of electric energy.

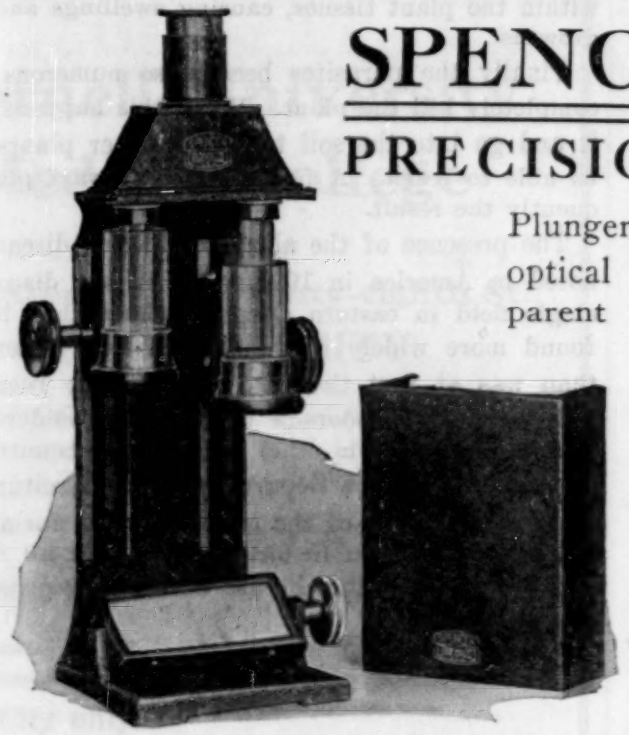
Explaining how this amount of water-power is obtained, he said: There are no great Niagaras in this empire west of the Rockies, hence the engineer has found it necessary to create artificial waterfalls. His general method is to go up into the mountain gorges, build a dam to store the water, convey this water through a ditch or tunnel, often ten to fifteen miles around the mountain side, at a gradient less than that prevailing in the main run of the stream, and thus create an artificial waterfall of 1,000, 1,500, and often even greater than 2,000 feet vertical drop. Through giant pipes these waters are dropped against water wheels often of record proportions, thereby developing electric power which in turn is transmitted to the farm, to the mine, to the home and to the various industries in the great cities of the West.

In discussing the present extent of water power utilization and future possibilities, Mr. Sibley called attention to the fact that California is a state of such proportions that if the northern boundary could be placed at the Woolworth Building in New York City, the southern boundary would be somewhere near Jacksonville, Florida, and he claimed that if the growth in population continues for the next 27 years at the rate maintained from 1910 to 1920, California will have a population in the generation immediately ahead of over 10,000,000 people.

EXPLORATION OF ANCIENT MEXICAN CIVILIZATION

Science Service

DURING the next ten years American archeologists will intensively study and excavate the ruins of the ancient Maya empires that flourished before the time of Colum-



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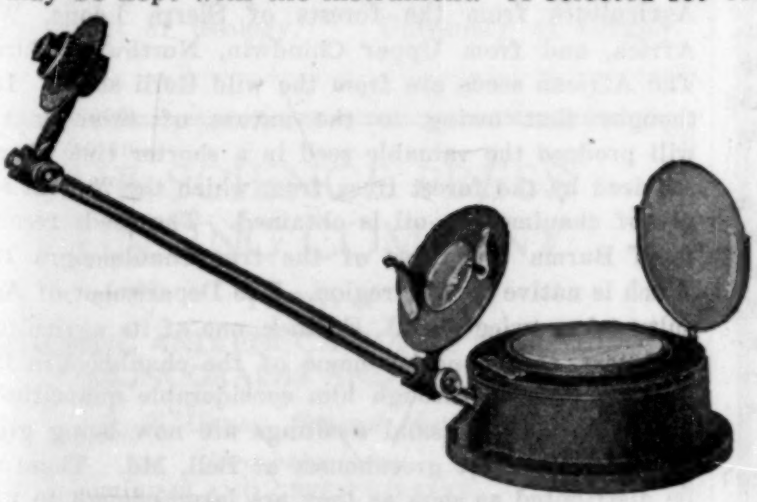

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bus in Yucatan, according to announcement made by the Carnegie Institution of Washington on August 13, when it made public an agreement with the Federal Government of Mexico giving it the privilege of enlarging the scope of the archeological work that it has begun in that region during the past decade.

The first ancient city to be unearthed is Chichen Itza in Yucatan, and Dr. Sylvanus G. Morley, in charge of field work, is now at the site supervising a force of laborers clearing off the tropical bush from the group of structures that will be studied first.

While the work will be concentrated at the ruins of Chichen Itza during the next field season beginning in January, the archeologists will later excavate other forest-covered cities in Mexico. An arrangement already made with the government of Guatemala allows archeological work in that country as well.

Every phase of the Maya culture will be studied, Dr. John C. Merriam, president of the institution, said in making the announcement. The engineering, architectural and artistic construction of the ancient structures, as well as the order in which they were built, will be studied intensively, and in order to secure an understanding of the conditions under which the Maya lived, the scientists will study the location of their cities, the geologic formations of the country, the climate, the weather and the relation of plants and animals to the food, clothing, medicine and other material needs of those ancient people.

Expert anthropologists will compare the physique of the surviving remnants of the Maya and Aztec peoples with evidences from the ruins, and languages will also be studied to determine possible relationships between the present and the past. The testimony of the Spanish explorers who met and subdued the ancient Maya will also be used in reconstructing the life of these true Americans.

ALFALFA'S FUTURE THREATENED

Science Service

PROMPT and aggressive action to save America's alfalfa and other crops from tremendous damage from the eel-worm disease is urged in an appeal issued by the United States Department of Agriculture through its Bureau of Plant Industry. Agents throughout the country were warned to be on the lookout for the tiny crop criminal which annually causes immense losses in South Africa and from which damage in several states of this nation has already reached alarming proportions.

The eel-worm is an organism, which is scarcely a twentieth of an inch long when fully grown, but causes a disease which shortens the life of the crop by several years, makes frequent plowing and replanting necessary, and reduces the yield. Under favorable conditions, experiments indicate that the alfalfa eel-worm may injure red, white and alsike clovers, buckwheat, English peas, turnips and even potatoes, as well as alfalfa.

As many as 200 eggs may be laid by one eel-worm, the young being about a tenth the size of the adults. Under moist conditions these migrate or are carried by irrigation water or other means to new plants. They penetrate the tender parts of these plants and grow to maturity within the plant tissues, causing swellings and abnormal growths.

Finally the parasites become so numerous that they completely kill the plant. When this happens they leave it and go into the soil to attack other plants they may be able to reach. A poor stand of dwarf plants is frequently the result.

The presence of the alfalfa eel-worm disease was first noted in America in 1921, when it was discovered in a single field in eastern Oregon. Since then it has been found more widely distributed in that general locality than was at first thought. It has also been found in California and Colorado and it is considered possible that it may occur in other parts of the country. Efforts will be made by the Department of Agriculture to secure a complete survey of the entire country during the present growing season in order to discover all infestations and to eradicate the disease before it becomes too generally established.

ITEMS

Science Service

A STAR that is nearer to the sun than any other star visible to the naked eye, except Alpha Centauri, has been discovered at the Harvard College Observatory by examination of its spectrum recorded on photographic plates, according to an announcement by Dr. Harlow Shapley, the director. Its name is Epsilon Indi and it is some 42,000,000,000,000 miles away from the solar system. It takes light only about seven years to travel from this newly recognized neighbor to the earth. Incidentally, Epsilon is classified by the Harvard astronomers as a decided dwarf so far as stars go. Alpha Centauri is 4.3 light years away, while brilliant Sirius, now displaced as second nearest star, is 8.8 years away when light traveling 186,000 miles a second is taken as a yard-stick.

SEEDS yielding large amounts of chaulmoogric acid, which has proved efficacious in the treatment of leprosy, have recently been received by the U. S. Department of Agriculture from the forests of Sierra Leone, West Africa, and from Upper Chindwin, Northwest Burma. The African seeds are from the wild Gorli shrub. It is thought that owing to the nature of this plant it will produce the valuable seed in a shorter time than is required by the forest trees from which the present supply of chaulmoogra oil is obtained. The seeds received from Burma are those of the true chaulmoogra tree, which is native to that region. The Department of Agriculture has twice sent J. F. Rock, one of its agricultural explorers, to the native home of the chaulmoogra tree, and has secured through him considerable quantities of seed. Several thousand seedlings are now being grown in the government greenhouses at Bell, Md. These will be distributed as soon as they are large enough to withstand shipment.

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About commencement time, June, 1923, a Leitz research petrographic microscope (practically new) disappeared from the petrographic laboratory at the University of Oregon. This microscope carries the following descriptive symbol: "SM" No. 0 No. 209681. Only one eye-piece and one objective were taken with it. All other accessories were lett. Anyone having any information as to an instrument answering this description will please communicate with

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SCIENCE NEWS

ASTRONOMICAL APPARATUS FOR THE ECLIPSE

Science Service

MASSIVE astronomical equipment to be used in observing the total solar eclipse of September 10 is now being transported from the Mount Wilson Observatory here to the Fort Rosecrans Military Reservation on the very tip of Point Loma, off San Diego Harbor. This will be the location of the central station of the Mount Wilson Observatory party in charge of Dr. Walter S. Adams, director.

The large structural steel framework with the two 30-foot photographic telescopes and numerous smaller attachments when erected at the station will make a novel sight for ships coming into the harbor.

This apparatus was constructed in the shops of the observatory and before transfer to Point Loma was set, adjusted and tried out.

At the Point Loma station an attack will be made upon the outlying regions of the sun known as the corona, and photographs of the stars in the neighborhood of the sun will be secured for a study of the bending of the light rays. For this work a battery of ten or a dozen instruments, including long focus cameras, radiometers, interferometers and spectrographs, have been mounted temporarily on the equatorial framework designed originally for the new 50-foot interferometer for measuring the diameters of the stars. This framework forms an admirable mounting for the various instruments which are so arranged that each can be pointed directly at the sun and all moved together by a driving clock to follow the sun during the time of the eclipse.

Another Mt. Wilson party will be located at Lakeside, 20 miles east of San Diego, which is just within the region where the sunlight will be completely cut off. The observations at this edge-station will be quite different in character from those at Point Loma. At Lakeside a coelostat will be used to reflect the sunlight to the instruments, and by the use of several spectroscopes it is hoped to photograph in detail the spectrum of the gases in the sun's lower atmosphere throughout the entire visible spectrum.

The prospect for good weather and clear skies is very encouraging in Southern California at this time of the year.

In addition to the observations to be undertaken in the path of totality it is probable that valuable photographs of the spectrum of the chromosphere and edge of the sun can be made on Mount Wilson with the powerful instruments there available. Although the eclipse is not total on Mount Wilson and the corona will not be visible, the fact that over 98 per cent. of the sun's disk will be covered will afford an exceptionally favorable opportunity for accurate studies of the character of the spectrum of the sun in the narrow crescent still exposed.

AIRPLANE OBSERVATIONS OF THE ECLIPSE

Science Service

USE of airplanes to photograph the mysterious rippling shadows which will probably flit across the landscape before and after the complete eclipse of the sun in southern California on September 10 has been proposed to the superintendent of the U. S. Naval Observatory at Washington by Colonel John Millis, army engineer, astronomer and physicist, of Cleveland. Direct observation of the sun from the air is also suggested as valuable in case clouds or fog should obscure the view of astronomers working on the ground.

"Shadow bands," or a series of faint wavering parallel lines of light and shade a few inches wide, have been frequently noticed dancing swiftly over the ground and the sides of houses from a few seconds to five minutes before and after solar eclipses become complete. Repeated efforts have been made to photograph this phenomena, with little success. Colonel Millis, however, thinks that the use of the airplane may enable astronomers to obtain a record of these strange shadows.

He admits that the faintness of such shadows and their small size will diminish the prospects of success, but holds that by the use of films of a high degree of sensitiveness and such color screens or filters as are used in taking photographs from airplanes during twilight and on cloudy days may prove effective in obtaining the record. He also advises systematic preliminary drills and practice over both land and water in taking pictures which bring out such small details as small waves and ripples on water, shadows of picket fences on the ground, furrows of ploughed fields or shingles on roofs.

Astronomers do not know the cause of the shadow bands, but it has been supposed that they are due to undulations and disturbances of the density of the atmosphere caused by the drop in temperature within the cone of shadow formed when the moon passes between the earth and sun. More accurate records have long been sought in order to have more definite material on which to work out their cause than can be obtained from the vague and varying descriptions of observers of these fleeting shadows.

The suggestion for the use of airplanes to photograph the "shadow bands" made by Colonel Millis has been forwarded to the Navy's Bureau of Aeronautics which will conduct an airplane pageant at San Diego during the time of the eclipse of the sun September 10. San Diego is within the region where the eclipse will be total and the shadow bands may be observed.

THE ADJUSTMENT OF CARBURETORS

Science Service

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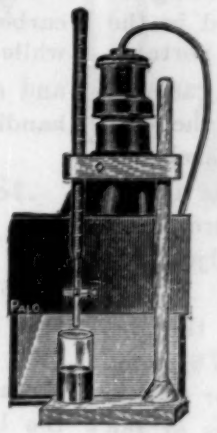

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following experiments made by the Bureau of Mines on the fleet of motor trucks used by the Government Fuel Yard in Washington. As the result of carburetor adjustments made by gas analysis in the bureau's experiments, an actual increased efficiency in mileage and saving of gasoline amounting to 22 per cent. was attained in the following month. The tests demonstrate that a portable carbon dioxide indicator for testing the exhaust gases of a motor vehicle gives a positive indication of the carburetor adjustment, removes all guesswork of such adjustment, is perfectly feasible practically, and is almost indispensable to a company having ten or more large trucks in service, especially if supplied with adjustable carburetors.

The Government Fuel Yard trucks tested by the Bureau of Mines ranged in capacity from 2½ to 7½ tons. During the winter months, when the demand for coal is heavy, from 30 to 35 trucks are used. Samples of the exhaust gas were taken on the trucks kept in service for summer hauling in order to determine the carburetor adjustment as used. Changes were then made to a more economical adjustment wherever possible, without sacrificing flexibility of operation and power. In every case the adjustments were maintained for maximum power, but were adjusted to the leanest position to give that power. In all but one case the carburetors were found to be adjusted too rich for maximum power and economy.

The actual increase in mileage and saving of gasoline due to the carburetor adjustments made by gas analysis, when the month previous and following the adjustments are compared, showed an increase in mileage of 22 per cent.; for the second month after adjustment, 16 per cent.; and for the third month, 9 per cent. When the mileage is compared truck for truck, and not taking into consideration the distance each traveled during the month, the increased mileage equaled 24.7, 21.2 and 16.2 per cent., respectively.

The adjustment of carburetors by analysis of exhaust gas is based upon the fact that the carbon dioxide in the exhaust is a direct indication of the air-fuel ratio and completeness of combustion. In turn, the air-fuel ratio and completeness of combustion tells whether the carburetor is properly adjusted for maximum power and gasoline economy.

Other conditions being constant, the mileage obtainable varies as the percentage of carbon dioxide in the exhaust gas and air-fuel ratio. This has been little realized by most garagemen in the past. The other factors are carefully watched and guarded against, while carburetor adjustment is usually left to the mechanic or driver who adjusts according to his own notions. Usually the adjustment is far too rich for maximum economy. There are, however, exceptions to this rule. A determination of the carbon dioxide content of the exhaust gas while the vehicle is being operated on the road gives a positive indication of the carburetor adjustment, and removes all guesswork.

The results of the Bureau of Mines experiments show that adjustable carburetors tend to become more richly adjusted with lapse of time, and that the adjustments should be checked at least every two months to maintain the most economical adjustments. If the monthly mileage is recorded, it becomes only necessary to check the adjustment of those that fall below the usual mileage which should be obtained when properly adjusted. The carbon dioxide indicator used for making the adjustments while the trucks were operated was found to be practical and easily operated by the laymen inexperienced in the handling of chemical apparatus.

SOFTWOOD FORESTS

Science Service

ALTHOUGH one fifth of the earth's surface is still covered with forests and there are over four acres of woodland for every man, woman and child on the globe, yet Raphael Zon and William N. Sparhawk, economists of the U. S. Forest Service, in a survey of the forest resources of the world just published, point out that the coniferous "softwood" forests of the northern hemisphere hold the fate of a world-timber supply problem in their depths.

Whether these coniferous forests that now supply more than three fourths of the lumber of the world will be able to meet the demands of the next two or three generations depends upon what steps are taken in the next few years to put them on a permanently productive basis.

Only 80 per cent. of the pine, spruce and other softwood timber cut is being replaced by growth. Softwoods, because of their light weight and ease of working are particularly adapted for construction use and a multitude of industrial uses for which the harder, heavier woods are not so suitable.

The best of the hardwoods of the temperate zone, including oaks, maple, ash, walnut, birch, beech and other kinds, are also being rapidly depleted. But the forest economists find that in the tropics there are vast reserves of hardwoods which can be substituted for any of those now used, and that the extreme rapidity of tree growth in the tropics makes it exceedingly unlikely that these supplies will be inadequate for centuries, if ever.

Fifty-six billion cubic feet of wood a year is used by the world, according to their estimates. Almost half, or 26 billion feet, is saw-timber, and nearly 30 billion feet is firewood. The firewood is equivalent in heating value to approximately one fifth of the world's consumption of coal.

ITEMS

Science Service

THE growing of limes in Dominica, the principal industry of that island, is threatened for the first time in its history with serious curtailment from the withering tip disease.

BIRD censuses covering a period of seven years indicate that there is a little more than one pair of birds to the acre of farm land in that section of the United States lying north of Maryland and the Ohio River and east of the Great Plains.

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SCIENCE NEWS

THE DESTRUCTION OF ICEBERGS

Science Service

How for the first time in the history of navigation members of the U. S. Coast Guard Service on duty as the International Ice Patrol blew up a mountain of ice with TNT in order to save ships plying the trans-Atlantic tracks from the fate of the *Titanic* is told by Edward H. Smith of the U. S. Coast Guard who had charge of the work.

An iceberg 350 feet long and with two peaks, the highest estimated to be 170 feet above the water line, had drifted well within the warm water of the Gulf Stream south of the Grand Banks of Newfoundland and seriously threatened the safety of large liners crossing the Atlantic. To remove this menace it was decided to attempt to destroy the berg.

Two TNT wrecking mines were lashed together and suspended six feet under water from a float. One of the patrol ship's boats placed this float close under a precipitous face of the berg. As they approached the huge ice mass a continual snapping and cracking, like rifle fire, greeted them, while they could see fissures continually darting and spreading through the ice of the disintegrating berg. Great care was taken in placing the mine and then the boat quickly pulled out of danger and fired the charge. Unfortunately a fog, which had closed in during these operations, shrouded the effect of the explosion. Those that stood on the deck of the patrol ship, a half mile from the berg, state that the report was followed by a terrific roaring and crashing, rivaling the heaviest thunder, as the iceberg broke apart.

The next day the berg was found to be appreciably smaller, but still of huge size, and another mine was used.

Each succeeding day the berg was drifting farther south and becoming a greater menace to steamships. On the fourth day, profiting by previous experience, the approximate center of gravity of the berg was determined, and it was decided to place the mine under a smooth wall of ice which was slightly overhanging. Attempt was made to drive a sharpened spike far enough in the ice to hold the mine to be suspended from it, but the motion of the boat prevented this. Attempts were also made to throw grapnels over the projections in the ice, but they failed to hold. Finally a line was shot across the berg so the projectile fell where it was desired to place the mine. The mine was then attached about thirty feet under water. All the time the boat was kept headed away from the berg, ready to pull off if the berg should start to topple an avalanche of ice from one of its summits.

"When the mine was fired," said Mr. Smith, "it produced a spectacle that is beyond description. A column of water was thrown nearly to the top of the berg. Thousands of tons of ice detached themselves and fell with a mighty roar into the sea. This caused the berg to lighten weight very considerably on the side toward us, rising to a very majestic height. About the time it attained its greatest height a great report was heard and the berg broke squarely in two pieces. The movement appeared to be very slow, in all probability due to the enormous size of the masses of ice."

This wrecking of the iceberg, Mr. Smith explained, undoubtedly removed a danger from the path of speeding liners several days earlier than would have been the case otherwise.

THE FOOD OF CORAL ANIMALS

Science Service

THE builders of coral reefs and islands are entirely meat eating animals, Dr. T. Wayland Vaughan, of the U. S. Geological Survey, told the Pan-Pacific Science Congress at its meeting in Melbourne last week. In experiments conducted by him in the Tortugas, in the Gulf of Mexico, corals persistently refused a vegetable diet, but even water fleas were not swift enough to dodge the tentacles of these carnivorous creatures.

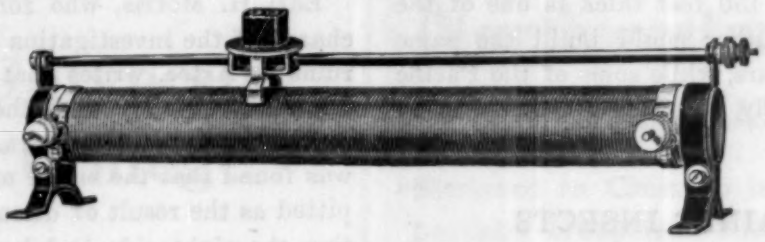
The living coral is a branched colony of individuals all connected together and with their soft bodies encased in strong cells. Each individual is little more than a stomach, with a mouth surrounded by tentacles and sheltered in a little cup of the limy skeleton within which the whole colony is enclosed.

Dr. Vaughan described how when a little beef juice or a small bit of meat, usually crab flesh or fish, was offered, the tentacles at the outer edge of the colony would begin to appear. Then the stimulus was transmitted to other members of the colony until soon the surface of the specimen had opened out like a beautiful flower. This condition seems to indicate that the coral colony is hungry and ready to capture food.

Corals have special mechanisms for catching food, including tentacles containing stinging cells and cilia, or hair-like extensions of the outer layer of the soft tissue which in response to certain stimuli beat toward the mouth opening, and in response to others beat away from it. The outer surface also secretes mucus in which particles of food may be embedded and this mucus is moved by the beat of the cilia either toward or away from the mouth.

Many different kinds of food were offered corals, Dr. Vaughan said, but they took only animal food. A piece of diatom mat was placed on one side of the oral disc, between the tentacles and the mouth, and a piece of crab meat on the other. Invariably the crab meat was seized and swallowed; while the diatoms induced no reaction except ultimately to be removed from the surface. No kind of purely vegetable food was taken by any one of the numerous species investigated. Pieces of plants coated with small animals or soaked in meat juice were swallowed but later the vegetable matter was ejected.

When hunger is entirely satisfied, the tentacles retract and the ciliary motion reverses and particles of food are moved away toward the outside edge of the colony.



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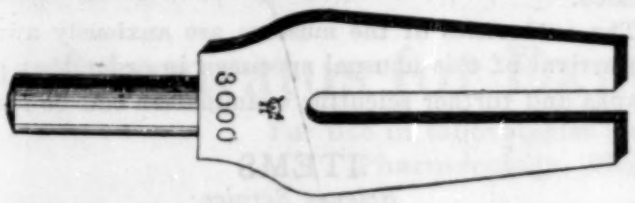

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At the rate of upward growth observed in the reefs of the West Indies it would take from 6,531 to 7,620 years for the formation of a reef 150 feet thick in one of the species examined, while another could build the same thickness of reef in 1,800 years, while some of the Pacific forms grow still more rapidly and might accomplish as much in 1,000 years.

ALLIANCE AGAINST INSECTS

Science Service

ENTOMOLOGISTS throughout the world are working together in the war against crop insects, according to Dr. L. O. Howard, chief of the Bureau of Entomology of the U. S. Department of Agriculture. Parasites which prey upon damaging insects and keep their numbers down in one country are constantly being drafted by the scientists for use in the fight against the imported pests of another country.

Many of the insects which have found their way into this country from other lands left their natural enemies behind them. In consequence they have been able to increase in greater numbers than at home with greater damage to plant life they infest. In order to restore the balance of nature, the entomologists study the life and habits of the insect in its home land. They discover what parasites prey upon it and keep its numbers down. Some of these parasites are then collected and brought to this country to help check the ravages on crops here.

The United States now has an expert in Mexico in search of parasites of the Mexican bean beetle. Another is studying the enemies of the threatening Mexican fruit-fly in that country. Two are in Japan seeking parasites of the Japanese beetle, while another is in that country looking for enemies of the gypsy moth which continues to destroy trees in New England. Two men are just back from Hungary where they also studied the gypsy moth whose native range is all the way from Europe across Siberia to Japan. But nowhere is it so damaging as in America.

Europe has furnished America more of the undesirable insect immigrants than any other section of the world, and the United States now has a complete laboratory with three experts at Heyeres, 70 miles east of Marseilles, France, for the study of the pests native to southern Europe.

Besides these American experts in the field, entomologists of the various nations are in constant communication and frequently make collections of parasites for each other. Generally such exchanges are from the older to the newer countries, but America has given effective help of this kind to Europe, notably in the case of parasites of the woolly root louse of the apple. This insect is a native of America, and until the parasites were supplied from here, it was doing great damage in France.

A TREPHINED SKULL FROM NEW MEXICO

AN archeological expedition sent out by the American Museum of Natural History and which has been engaged in field work at Mitten Rock in the Navajo Reservation, New Mexico, has sent word that they have just made an unusual find in that country.

Earl H. Morris, who for a number of years has had charge of the investigation and restoration of the famous ruins at Aztec, writes that while making excavations at Mitten Rock they unearthed a human skull which presented an unusual appearance. When freed of earth it was found that the entire upper portion was knobbed and pitted as the result of disease of long standing. In addition the right side had been extensively trephined. An oval section, approximately two inches in length and one in width, had been removed from the frontal bone immediately above the right eye. Presumably this operation was performed, as among other primitive peoples, in an attempt to relieve pain. The skillful manner in which the ancient surgeon used his flint knives is revealed by the smooth, even edges of the bone. However, the fact that these show no evidence of healing proves that the individual did not long survive the ordeal.

Mr. Morris further states that the person to whom the skull belonged was of the brachycephalic, or short-headed type, and of short stature. A people possessing these physical characteristics inhabited the San Juan Valley before the development of the Pueblo Cliff Dweller culture which was in existence for many centuries, if not for thousands of years previous to the discovery of America by Europeans.

Thus the trephined specimen is of relatively great antiquity and of commensurate scientific importance. No other instance of trephining has been discovered among aboriginal skulls from the Southwest, and only two others have been recorded from North America north of Mexico.

The authorities of the museum are anxiously awaiting the arrival of this unusual specimen in order that photographs and further scientific examination can be made.

ITEMS

Science Service

NOTWITHSTANDING reported privations of the people of Germany, the death rate of that country is now the lowest of record, according to a correspondent of the American Medical Association. The previous low record was in 1913. The most probable explanation is thought to be the reduction of the birth rate in recent years, since a large part of the mortality rate has always been due to the deaths of young children.

ENVIRONMENT has so much to do with the causation of mental disease that the control of heredity through segregation or sterilization of mental defectives should not be considered the only hope of solving the social problem of mental deficiency, Dr. Abraham Myerson, of Boston, told members of the American Psychiatric Association in their annual meeting in Detroit. The most fruitful working hypothesis for students of mental disease is to regard the environment as responsible, and to undertake research in that direction rather than to take refuge in any hypothetical unit character defect or alteration. Investigation must be carried on by studies of patients themselves and by laboratory methods, and not by merely statistical studies of heredity.

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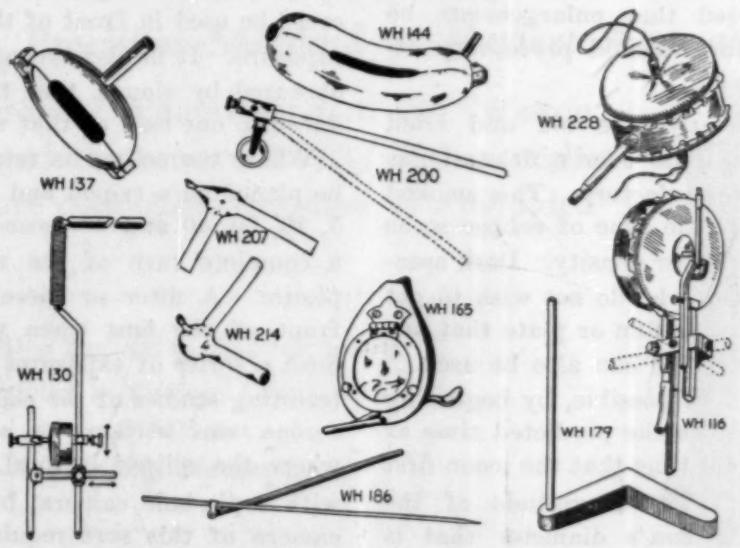

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SCIENCE NEWS

HOW TO OBSERVE THE COMING ECLIPSE OF THE SUN

Science Service

EVERY one can have the thrills of an astronomer during the coming eclipse of the sun on Monday, September 10.

This great astronomical event will be visible in its partial phase in all parts of North America, and although the darkening will be total in only a small part of California and Mexico, the amateur can make many observations at home without the trouble of traveling to this area.

Amateur observations, like those of professional astronomers, can be both visual and photographic.

Plan your program carefully in advance of the eclipse time. Pick out a location from which the sun will be easily visible and where no smoke, dust or clouds are likely to obscure the spectacle.

Dozens of crescent suns can be observed if you will look under shady trees and on tree shaded walls while the eclipse is in its partial phases. These images, with the horns of the crescents turned in an opposite direction to those of the sun above, have a striking appearance. Tiny holes in the leaves act as lenses, as they do in pin-hole cameras, and form the images with the ground or wall as a screen. In ordinary times when the sun's light is not in conflict with the moon, the sunlight filters through the leaves in a series of tiny, overlapping disks on the ground, each round since it is an image of the sun. In photographing the crescent images of the eclipse period, an ordinary snapshot exposure with a large stop in the lens may be used. These exposures should be developed full time. Because of the fact that the images obtained with ordinary hand cameras will be quite small, it is recommended that enlargements be made and these enlarged pictures should prove very attractive.

For observing the sun directly, the old and tried method of smoking a piece of glass over a fish-tail gas jet or with a candle will prove satisfactory. This smoked glass should be prepared before the time of eclipse so as to obtain a carbon coating of proper density. Dark spectacles will be popular with those who do not wish to get their hands dirty. A photographic film or plate that has been exposed to light and developed can also be used.

With such eye shields it will be possible, by beginning observations a few minutes before the predicted time of eclipse, to check up on the actual time that the moon first infringes on the sun's disk. The magnitude of the eclipse, or the amount of the sun's diameter that is covered by the moon can also be estimated through the protectors and also the time that the moon passes off and ends the eclipse should be noted. A drawing of the sun showing the location of the points at which the eclipse began and ended would be an interesting record.

The eye strain of looking directly at the sun can be obviated by using the pin-hole method of observation. A hole is punched with a fine needle through a piece of cardboard or dark film and a smooth white card is used as a screen. The needle-hole acts as a lens since it is so small. Rays from opposite edges of the sun pass each other in going through the hole and the result is a perfect image of the sun on the cardboard screen that can be enlarged if desired with a small magnifying glass. This simple apparatus can be constructed and tried out on the uneclipsed sun.

To get the most effective and interesting photograph of the partial eclipse, a series of exposures should be made at intervals of say five minutes covering the duration of the eclipse. For this the camera should be placed on a tripod, the legs of which are arranged so that the camera points upward sufficiently to show the image of the sun in the upper right corner of the Kodak finder. All preparations should, of course, be made before the eclipse starts.

In localities where the eclipse starts with the sun low enough in the sky, it would add to the pictorial value of the picture to include the horizon line in the picture area. As to exposure, it is suggested that the smallest stop be used in the lens and that the shutter be set for the fastest speed. Then make one exposure every five minutes without turning the film for the duration of the eclipse. A single exposure can, of course, be made of the eclipse, in which case, the camera can be held in the hands, but a succession of images at equal distances apart will make a more effective showing.

A color filter would aid in preventing overexposure if the day is unusually clear, and the atmosphere free from haze. No change should be made, however, in the stop and shutter speed combination mentioned above, even if a very deep colored filter, such as the "G," is used on the lens. In place of the filter a piece of film that has been flashed to light and developed to a good density could be used in front of the camera lens to prevent overexposure. It is also recommended, that if the sun is not obscured by clouds, that the time of development be reduced to one half of that which would be given normally.

Where the eclipse is total, however, the camera should be placed on a tripod and a succession of exposures of 2, 5, 10, 20, 40 and 60 seconds made, the film being wound a complete turn of the winding key between each exposure. A filter or piece of film need not be used in front of the lens when photographing a total eclipse. Such a series of exposures just mentioned should give interesting studies of the eclipse and the sun's corona. The corona can neither be seen nor photographed except where the eclipse is total. A record could be obtained with a pin-hole camera, but to make a really successful camera of this sort requires a little knowledge of photography and would necessitate some previous experimenting as to exposure time.

The common box camera equipped with lens and shutter will make excellent pictures. Motion-picture cameras could be used, exposing at intervals several feet of film during the partial eclipse and cranking continuously during the several minutes of totality. An amateur motion-picture camera, like the new Cine-Kodak, could be used.

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GIANT FOSSIL REPTILE TAKEN TO CAPITAL

Science Service

DIPLODOCUS, the gigantic eighty-five foot long reptile which over eight million years ago waded through the swamps of what is now Utah, has just arrived in Washington. Dr. C. W. Gilmore, paleontologist of the U. S. National Museum, has reached here with the twenty-five tons of sandstone and fossil remains of this monster which were chiseled from the cliffs near Vernal, Utah, and hauled 152 miles across the mountains to the railroad.

Five years will probably be required to free the fossilized bones from the stone in which they are imbedded and mount the huge skeleton in the position in which it probably stood when alive. When completed it will be made the central feature of one of the large halls of the museum.

Some eight to twelve million years ago, this fossil creature was alive from the end of its slender tapering tail to the top of its head on its long neck and stood fourteen to sixteen feet high at the hips. It could stand in water forty feet deep with its feet on the bottom and thrust its head above the surface. It is estimated that alive and in its skin it weighed from sixteen to eighteen tons.

Since its time, rocks have been laid down burying the lagoons and swamps in which it lived some 10,000 feet below the most recent strata. The forcing up and folding of the layers of rock to form mountains brought these ancient rocks up to where the fossils were found, a locality set aside some years ago as Dinosaur National Monument and from which the Carnegie Museum of Pittsburgh has taken many specimens of the same species.

What were once low swamps have been raised during the ages to 4,000 feet above sea level. After cutting the fossils and their surrounding sandstone from the cliff, the twenty-five tons of material representing the remains of this swamp-living creature were carried 5,000 feet higher to get them across the mountains to the railroad 152 miles away.

One of the seventeen vertebrae of the neck of the diplodocus was three feet long, while one of the pelvic bones weighed, as boxed, nearly 2,000 pounds. For shipment the fossils were roughly hewn out of the stone, and much careful work will be required to remove the remaining rock from around the fossilized bones.

THE "DEVIL'S GRIP"

Science Service

"DEVIL'S GRIP" is an infection but the elusive germ that does the work is still at large. This sums up the status of the inquiry into the cause of this strange disease now prevalent in Virginia, as reported by Dr. George C. Payne, epidemiologist of the Virginia State Board of Health, and Charles Armstrong, past assistant surgeon in the United States Public Health Service.

The epidemic appears to be confined to rural communities and to be spread within families by contact. Children are more frequently attacked than adults. The symptoms point to an inflammation of the surface of the diaphragm and the disease might be called, technically, epidemic transient diaphragmatic spasm, and is quite possibly related to some of the other infectious conditions which follow the epidemics of influenza.

The condition was first reported by Dr. Maud M. Kelly, of the State Board of Health, of Virginia last month. She had seen a number of persons in Hanover County who had recently suffered from an illness characterized by an acute onset, with abdominal pain but without the usual history of summer digestive disturbances. On July 21, similar cases were reported in Carolina County and since that time they have appeared throughout the northeastern part of the state. Cases have been reported by thirty-eight physicians from twenty-two counties. A similar disease appeared in Virginia in 1888 and was described by Dr. W. P. Dabney under the name "Devil's Grip." His paper was called, "An account of an epidemic resembling dengue which occurred in and around Charlottesville and the University of Virginia in June, 1888." The attack comes on suddely with severe abdominal pain which later extends to one or both sides of the lower part of the chest cavity. Breathing is difficult and rapid. The temperature rises in practically all cases and there is intermittent pain. Most of the patients perspire freely. The pain is increased on movement and in some cases by swallowing. In general, the patients are constipated, but the condition is followed by diarrhoea. Most of the patients complain of headache and pain in the back. After from four to ten hours of severe pain and difficult breathing, the condition begins to subside, but there may be relapse. Most of the patients recover without any secondary complications.

INFANT MORTALITY AND ITS CAUSES

Children's Bureau, U. S. Department of Labor

RESULTS of an extensive investigation into infant mortality and its causes in Baltimore, Maryland, have just been made public by the U. S. Department of Labor through the Children's Bureau.

This study is the latest and in many respects the most important of the infant mortality studies made by the bureau (previous investigations having been made in Johnstown, Pa., Manchester, N. H., Waterbury, Conn., Brockton, Mass., Saginaw, Mich., New Bedford, Mass., Akron, Ohio, Pittsburgh, Pa., and Gary, Ind.).

The Baltimore study is especially important because Baltimore is the largest of the cities studied, and also because it is, in its population, the variety of its industries and the rate of infant mortality prevailing, a typical American city.

Poverty, employment of mothers outside the home, housing below the proper standard, short intervals between births, and the death of mothers at or soon after child-birth were among the conditions causing high death rates among certain groups of babies under one year of age, in Baltimore. Similar conditions were found responsible for high infant mortality rates in other cities.

A summary of the findings of the Baltimore report is as follows:

The mortality in the entire group of 10,797 legitimate

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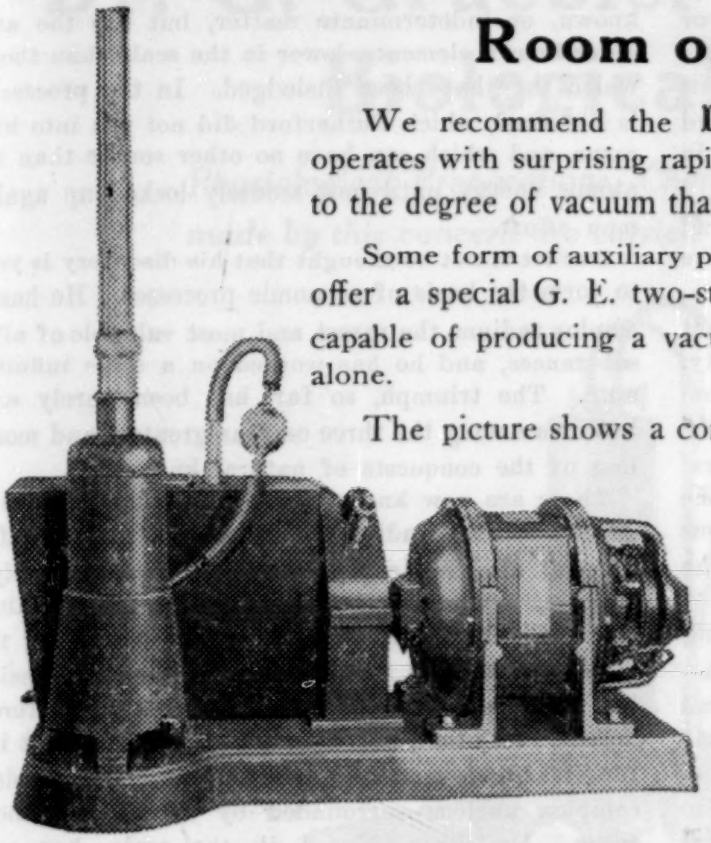

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Our new Student's Polariscope is a scientific instrument showing by the interference of light waves the remarkable color effects of polarized light. It provides one of the most fascinating experiments in Elementary Physics and constitutes a never-ending source of instruction and enjoyment.

The instant favor with which our larger Polariscopes were received, has led us to offer a smaller instrument containing all essential parts at a price well within reach of every school and college. Daylight or artificial light diffused by a ground glass plate is reflected at a polarizing angle by a black glass mirror to the stage. The stage may be rotated or shifted up and down the rod and carries a glass plate and clips for holding the object under examination. The latter is viewed through a nicol prism analyzer which rotates in a collar graduated to 5°, making quantitative measurements possible.

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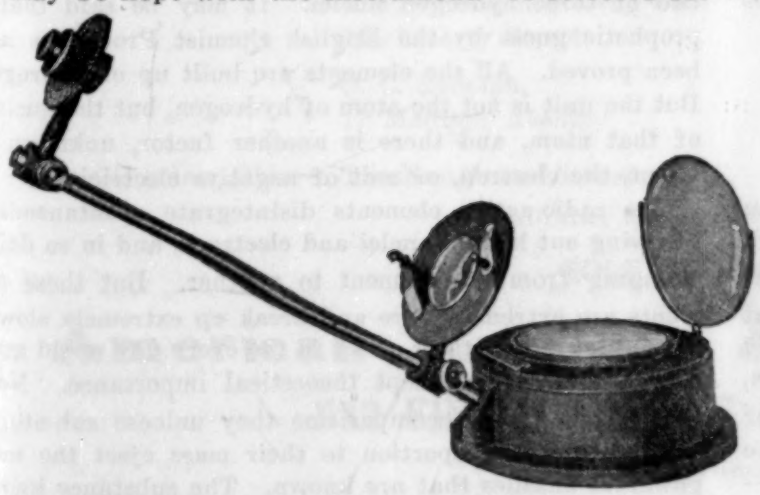

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births studied was approximately the same as the infant mortality in the cities of the United States birth-registration area for the same year.

Mortality rates markedly above the average for the entire Baltimore group occurred among the colored families, foreign-born Polish families, and the very poor native white families.

Low mortality rates—approximating those in New Zealand, which has the lowest in the world—were found among the babies of foreign-born Jewish mothers and in families of the highest earnings groups.

Breast-fed babies in every group of the population had lower mortality than artificially-fed babies in the same group.

New evidence is afforded by the Baltimore study that poverty is an important factor in infant mortality. Eliminating differences in color and nationality and considering only the babies born to native white mothers, the facts showed that infant mortality rose as the fathers' wages fell. In the poorest families studied about one baby in six died within the year; in the most prosperous families about one baby in twenty-six died within the year.

Employment of the mother away from home during pregnancy (which was chiefly in factory work) was accompanied by a high percentage of premature births and high infant mortality, especially from the causes peculiar to early infancy. Employment of mothers away from home during the first year of their babies' lives also markedly increased the hazard to the baby. Room congestion and lack of sanitary equipment in the house were accompanied by death rates above the average.

First-born babies had a mortality slightly higher than second or third babies, but among the later orders of birth the mortality rose steadily.

Babies of mothers under twenty and of mothers of thirty-five years or older showed higher mortality rates than other infants.

Births following a preceding birth by an interval of less than two years had a higher mortality than births occurring after a longer interval.

The babies born to the 105 mothers who died within the year following the babies' birth had the highest mortality in the entire group. When the mothers died within two months after the babies' birth, the infant mortality rate became six times as high as the rate for babies whose mothers lived.

TRANSMUTATION OF THE ELEMENTS

London Times

NEXT month, at Liverpool, we shall expect to hear from Sir Ernest Rutherford, president-elect of the British Association, some account of his recent progress in transmuting elements and liberating sub-atomic force. What he is known to have accomplished already may be stated shortly. Of the eighty-seven known chemical elements, hitherto in practice, if not in theory, ultimate pieces of matter, distinctive moulds into which the stuff of the universe in cast, he has succeeded in transforming six—boron, nitrogen, fluorine, sodium, aluminium and phosphorus.

His method has been to knock chips from the atoms of these elements; the fragments removed are not scraps of unknown or indeterminate matter but are definitely known substances; the mutilated atoms also are not unknown, or indeterminate matter, but are the atoms of other known elements, lower in the scale than those from which they have been dislodged. In the process energy is liberated, which Rutherford did not put into his apparatus, and which can have no other source than the sub-atomic energy until now securely locked up against human effort.

But let it not be thought that his discovery is yet ready to form the basis of economic processes. He has had to employ radium, the rarest and most valuable of all known substances, and he has worked on a scale infinitely minute. The triumph, so far, has been purely scientific, but it is among the three or four greatest and most startling of the conquests of natural knowledge.

There are now known to be ninety-two species of elements, which, studied by Moseley's method of X-ray spectral analysis, can be arranged in an orderly series from 1, Hydrogen, the lightest, to 92, Uranium, the heaviest. Of these, all but the five occupying numbers 43, 61, 75, 85 and 87 have been isolated and their chemical properties studied. The unit of the different elements is an atom, but the atom of each element is a different arrangement of a common stuff. It consists of a complex nucleus surrounded by satellites termed electrons. Hydrogen, No. 1 in the scale, has only one satellite electron, and each successive element differs from its lower neighbor by having one more electron satellite, until Uranium is reached at the top with 92 electrons. The one, or many, satellites revolve at a relatively great distance from the nucleus, the space occupied by their orbits being many thousand times that occupied by the nucleus. They have a vast importance in the chemical qualities of the atom, but the essential difference between one atom and another resides in the nucleus.

The nucleus of an atom is a closely bound assemblage of nuclei and electrons. It is of such a kind that the nucleus of helium contains only hydrogen nuclei, together with electrons, and the nucleus of each higher element consists of so many helium nuclei with either two or three hydrogen nuclei. It may be said that a prophetic guess by the English chemist Prout has now been proved. All the elements are built up of hydrogen. But the unit is not the atom of hydrogen, but the nucleus of that atom, and there is another factor, unknown to Prout, the electron, or unit of negative electricity.

The radio-active elements disintegrate spontaneously, throwing out helium nuclei and electrons, and in so doing changing from one element to another. But these elements are extremely rare and break up extremely slowly, so that, so far as their effect in the every-day world goes, they are of little except theoretical importance. None the less, in their decomposition they unloose sub-atomic energy, and in proportion to their mass eject the most powerful missiles that are known. The substance known as radium-C, for example, throws off what are known as

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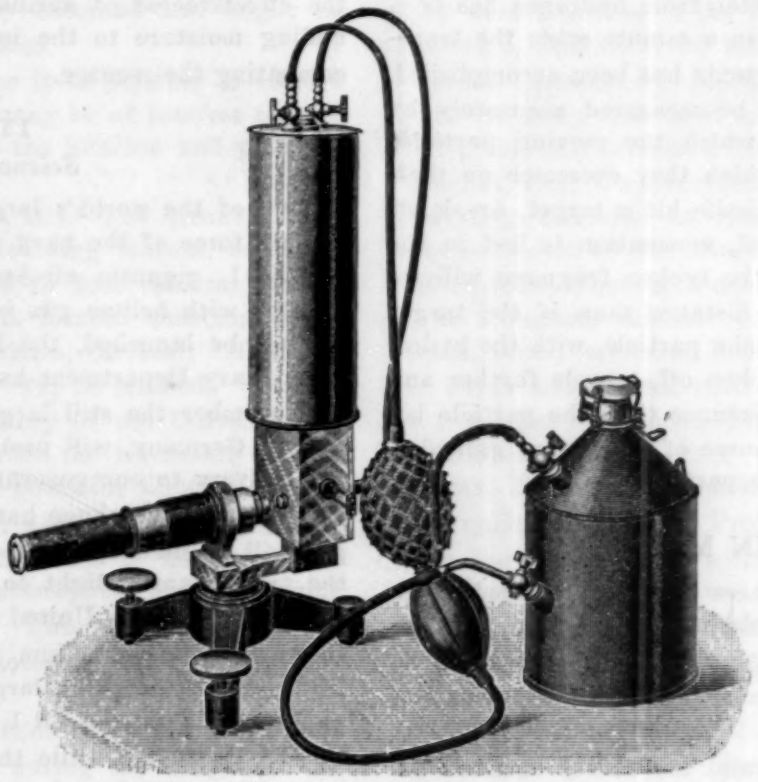

Fig. 1

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alpha particles. These are helium nuclei shot out at a velocity of 12,000 miles a second, and, mass for mass, with about four hundred million times the velocity of a rifle bullet.

Sir Ernest Rutherford has used these missiles to bombard the atoms of a large number of elements. Only very few of the shots take effect, but a certain very small proportion penetrate the orbits of the satellite electrons and reach the nucleus itself. In the case of the six elements already mentioned, when a shot does take effect it chips off a piece of the nucleus; the piece broken off in each of the six cases has been proved to be a hydrogen nucleus and the remaining piece becomes a new element. Thus the building up of matter from hydrogen has been experimentally proved, and on a minute scale the transmutation of some of the elements has been accomplished.

The forces liberated can be measured accurately by measuring the distance to which the moving particles travel and the resistances which they overcome on their journeys. If an ordinary missile hit a target, break off a piece and carry it forward, momentum is lost in the impact and the missile and the broken fragment will together travel for a shorter distance than if the target had been missed. But the alpha particle, with the hydrogen nucleus which it has broken off, travels farther and is able to overcome more resistance than the particle before its impact. The only source of the energy gained is the sub-atomic energy of the particle.

SAFETY IN MINES

TWELVE thousand coal miners are being trained annually by the government in safety methods of mining, rescue and first-aid work, according to an estimate made by the Department of the Interior through the Bureau of Mines.

Ten mine rescue stations and ten safety stations are now being maintained throughout the mining sections of the country that assist in rescue and recovery operations in mine disasters. In addition the Interior Department maintains nine rescue automobile trucks that have proved of great value for quickly rushing to nearby accidents and for mobile training units in regions not easily reached by rail.

The miners trained by the government form a nucleus of safety crews in the mining industry and most companies now maintain efficient and well organized safety departments with privately operated rescue stations. A useful agency in maintaining interest among miners is the Joseph A. Holmes Safety Association which was organized by the Bureau of Mines of the Interior Department and now has chapters all over the country.

The purpose of the organization is to prevent accidents, improve health conditions, facilitate training in mine rescue, first aid and safety methods and promote recreational activities. Government engineers also investigate all coal mines in which disastrous explosions or fires occur, and make a detailed study of the conditions to determine the way in which the fire or explosion originated. Recommendations are then made to the mine operator, as to what steps he should take for preventing any future recurrence.

In the past 14 years 300 coal-mine disasters have been studied, and the records constitute an invaluable guide on the causes and mode of occurrence. Large-scale tests of the explosibility of coal dust and mine gases, conducted over many years, in the department's experimental mine near Pittsburgh, the only underground mine in the world dovoted to experimental work, have conclusively demonstrated to mine operators the fact that coal dust is an explosion hazard, alone or with gas present.

The Interior Department also has determined the exact degree of explosibility of representative dusts from hundreds of mines, and the proportions of inert dust which must be added to render the coal dust harmless, the effectiveness of sprinkling the roadways and walls, adding moisture to the intake air and other means of combating the menace.

ITEMS

Science Service

TWO of the world's largest airships will be added to the air force of the navy this fall. About September 1 the ZR-1, gigantic all-American built ship now being inflated with helium gas in its hangar at Lakehurst, N. J., will be launched, the Bureau of Aeronautics of the U. S. Navy Department has just announced. Some time in November the still larger ZR-3, now nearing completion in Germany, will probably be flown to this country for delivery to our government. Both ships are to have their home in the huge hangar at Lakehurst. Hydrogen gas will be used by the German builders of the ZR-3 in the transatlantic flight to deliver the big ship. When turned over to the United States, it will be refilled with the non-explosive helium gas for actual service. The ZR-3 will be slightly larger and somewhat heavier in appearance than the ZR-1 built in this country. It will be 660 feet long, while the ZR-1 is 680 feet in length. But, although twenty feet shorter, it will have a diameter of 92 feet as compared to 79 feet, the diameter of the ZR-1. It will have a total gas capacity of 2,400,000 cubic feet as against 2,100,000 cubic feet gas capacity of the American built ship. The German built craft will be driven by five Maybach 400 horsepower engines, while the power plant of the ZR-1 consists of six 200–300 horsepower Packard engines.

THAT creosote oil offers the first practical method yet discovered for protecting the crudely built homes of negro tenants on many farms in the southern states from malaria-carrying mosquitoes is indicated in a preliminary report of experiments in Yazoo County, Miss., by C. P. Coogle, acting assistant surgeon of the U. S. Public Health Service. Observation of the difference in numbers of mosquitoes under creosoted timber bridges of a railroad and on the untreated timbers of bridges on a parallel county road near by led to the discovery.

TWENTY miles of pearl oyster beds that will begin to yield in 1926 have been discovered in the Gulf of Mannar, at the lower tip of India. Government officials in India predict that the largest pearl fisheries of a century will develop. The new beds are directly opposite the ancient fisheries of Ceylon exploited by the Greeks and Romans.

SCIENCE NEWS

EXPEDITIONS OBSERVING THE ECLIPSE

Science Service

ASTRONOMERS from all over the world were stationed on Monday at advantageous points along a 100 mile wide strip in California and Mexico ready for the total eclipse of the sun. Massive and expensive telescopes, cameras and other apparatus were erected at advantageous points, corps of scientists were carefully drilled and many days were spent in preparation for the event. All this was done in order that the totally obscured sun might be observed for about three minutes.

SCIENCE goes to press before it is possible to receive any news of the results, but it may be of interest to give some information in regard to the location and plans of the various expeditions.

Point Loma, near San Diego, Cal.—The Mount Wilson Observatory's main eclipse observing station, equipped with two 30 foot cameras, one 15 foot camera, various telescopes and spectrographs, is located here under the direction of Dr. Walter S. Adams, director. Both the corona and the Einstein effect will be studied.

Leander McCormick Observatory of the University of Virginia has an expedition under the leadership of Dr. S. A. Mitchell, equipped with powerful Loucan grating spectrographs that are located near here at the center and edge of moon's shadow in order to determine the vapors constituting the sun's atmosphere and the height to which the vapors ascend. Two stations are being occupied for the purpose of photographing different layers of the solar atmosphere.

Prof. Charles Le Morvan heads a French expedition located here to study the sun during the eclipse.

Scientists from the Department of Terrestrial Magnetism of the Carnegie Institution will make elaborate magnetic observations in connection with Mount Wilson Observatory observations.

San Diego, Cal.—Army and Navy aviators are ready to attempt for the first time eclipse observation from airplanes. Lieut. John A. Macready, holder of the world's altitude record, and Lieut. A. W. Stevens, expert aerial photographer, plan to photograph surface features and the moon's shadow from an altitude of 20,000 feet. If clouds prevent observations from the surface, they will photograph the sun itself. Navy pilots at the request of the U. S. Naval Observatory will make photographs of the northern and southern edges of the path of the shadow cast on the earth during the eclipse to allow checking of computations of eclipse time. They will also photograph the "shadow bands" that pass across the landscape just before totality.

Santa Catalina Island, Cal.—An expedition from Yerkes Observatory of the University of Chicago, under direction of Dr. Edwin B. Frost, will make motion pictures of the eclipse, obtain large scale photographs of the corona with a 60 foot telescope, and make spectroscopic observations at a station located 1,300 feet above sea level. Santa Catalina Island is off the coast of California opposite Los Angeles.

Lakeside, Cal.—A second party from the Mount Wilson Observatory will study spectrum of gases in the sun's lower atmosphere.

Ensenada, Lower California, Mexico.—Lick Observatory of the University of California has an expedition located near here under the direction of Dr. W. W. Campbell, president and director. Observations will be concentrated on the corona problem and the party is equipped with large cameras, telescopes and spectrographs. Many of the astronomers connected with the party were members of the Lick Observatory, Australian expedition, that observed the eclipse of last year.

Lowell Observatory, located at Flagstaff, Ariz., will locate its party near here under the direction of Dr. V. M. Slipher, and extensive observations are contemplated.

Parties from the University of Indiana and De Pauw University will also be located here. Ensenada is 75 miles southeast of San Diego.

Hermosillo, Sonora, Mexico—A party headed by Dr. A. E. Douglass, director of the Steward Observatory, Tucson, Ariz., is located here with a five-inch lens of 39 feet focus and several other instruments. In the party are a number of amateur astronomers.

Yerbaniz, Mexico—The principal expedition from Mexican National Astronomical Observatory of Tacubaya, under direction of Prof. Joaquin Gallo, will photograph the sun's corona with two cameras of long focal length, and observe the sun's spectrum with special apparatus. A cinematographic camera will also be used. The personnel includes an engineer, calculator and mechanic.

Senor Rosendo Sandoval of the Mexican Magnetic Observatory will make special magnetic observations here.

Sproul Observatory of Swarthmore University has an expedition under the leadership of Dr. John A. Miller located here with its principal object the study of the corona of the sun. A camera of 65 foot focal length and other instruments are erected ready for the total eclipse. This expedition has taken out a policy for $10,000 insuring the securing of corona photographs of scientific value.

Yerbaniz is a small railroad station, located midway between Durango and Torreon.

Berrendo, Mexico—Second party from Mexican National Observatory is located here under direction of Prof. Jose Maria Chacon, who is accompanied by another astronomer, a mechanic, and Francisco Estanol, photographer and artist. Motion pictures will be taken and the artist will sketch the total eclipse. This party is also equipped with a photoheliograph and several telescope cameras. Berrendo, in the state of San Luis Potosi, is located a few kilometers north of Charcas in the same state.

Pasaje, Mexico—A German expedition under the leadership of Dr. Ludendorff, director of the Potsdam Observatory and brother of the general, assisted by Prof. Richardo Shorr, director of Bergedorf Observatory, and A. Kohlshutter, A. D. Dolberg and W. Herman, are en-

camped near this station where they will make extensive observations of the sun. Pasaje, near Cuencame, is a few kilometers north of Yerbanis.

Teoloyucan, Mexico—The Mexican Magnetic Observatory here will make special magnetic observations during the eclipse of the sun. Teoloyucan is twenty-two miles north of Mexico City.

PAST AND FUTURE ECLIPSES

Science Service

FAMOUS eclipses have been as follows:

Oct. 22, 2136 B. C. First recorded eclipse observed in China.

May 28, 585 B. C. First eclipse known to have been predicted, a mathematical feat performed by Thales of Miletus.

Aug. 30, 1030. Red light of corona of eclipsed sun frightened soldiers in battle at Stiklastad, Norway.

May 30, 1612. First eclipse seen "through a tube" or telescope.

October 27, 1780. First American eclipse expedition from Harvard University.

July 8, 1843. This eclipse marked the beginning of physical research on the sun.

July 28, 1851. First photograph of eclipse made in Germany.

Aug. 18, 1868. Janssen, French astronomer observing in India, determined from spectrum of solar prominences that they are enormous masses of highly heated gaseous matter. Observation revealed spectral line of helium, not discovered on earth until nearly thirty years later.

December 22, 1870. French astronomer, besieged in Paris, escaped by balloon carrying parts of telescope only to have observations spoiled by clouds. Prof. C. A. Young discovered "flash spectrum" and also line in corona spectrum attributed to hypothetical element "coronium."

May 29, 1919. Photographs by two British expeditions showed bending of light rays from stars as predicted by Einstein.

September 21, 1922. Lick Observatory party in Australia confirms Einstein effect.

Total obscurations of the sun during the next five years will take place:

Jan. 24, 1925, visible in New York City and eastern United States.

Jan. 14, 1926, visible in eastern Africa, Sumatra and Philippines.

June 29, 1927, visible in England and Scandinavia.

May 19, 1928, visible in Antarctic Ocean.

CAUSE OF THE JAPAN EARTHQUAKE

Science Service

THE devastating earthquake in Japan undoubtedly originated in part in the sea off the the coast of that island empire, Prof. Andrew C. Lawson, of the University of California, who has just gone to Washington to head the National Research Council's division on geology and geography, explained to a *Science Service* representative.

A great break in the ocean bottom occurred, allowing one side to slip past the other and drop for probably a dozen feet, carrying with it many millions of tons of sea water. The ocean rushing into the vacated space set up the so-called tidal waves that, oscillating back and forth like water in a tub, swept the Japanese coast. The violent shaking of the earth that caused destruction and started the fires was a result of the slipping of two portions of the earth's crust past each other.

The extremely deep portions of the oceans seem to be associated with the areas where earthquakes are most frequent, Prof. Lawson pointed out. Just off the east coast of Japan is a long depression in the ocean's floor called the "Tuscarora deep." Similar depths of the sea, found off Chile, the Philippines, Jamaica and the Aleutian Islands in Alaska are regions where earthquakes are frequent.

Earthquakes occur when strains in the earth's crust become too great and find relief in slips and breaks, Prof. Lawson said. He likened the crust to a board that when stressed by a weight will finally give way with a sudden crash. The rocks of the earth are elastic like steel and will stand a certain amount of strain before they are relieved by sudden movement.

Japan is noted for the progressive piling up of strains that result in earthquakes. Prof. Lawson recalled the quake of 1891 in Japan that left an abrupt cliff as high as eighteen feet in some parts of the zone.

Scientists know that there are various regions of the world, like Japan, the coast of California, the Alaskan coast, Chile and New Zealand, where the earth's surface is unstable and where adjustments are now in progress.

Eventually it may be possible for scientists to predict earthquakes, Prof. Lawson believes. Extensive investigations are now under way by the U. S. Coast and Geodetic Survey in California that show that there is a crustal creep there of about three feet in ten years relatively to the Sierra Nevadas. Several years ago the National Research Council pointed out the need of seismologic study and the Carnegie Institution with the cooperation of other scientific bodies is making an intensive study of California, which was selected because of the work previously done on the San Francisco earthquake of 1906. The U. S. Coast and Geodetic Survey has had survey parties in the field for the last two years to determine the rate of movement there. Prof. Lawson considers this slow displacement as a strain creep, which accumulates till relief is effected by a sudden slip or a rupture in the earth's crust.

"After years more of such research," said Prof. Lawson, "I believe that it may be possible to predict about when the strains that are indicated by these movements will be released and cause an earthquake, but exact prediction is not likely to be obtained. We can not draw conclusions from our present data because we do not know how earthquakes, often very slight in one part of the area, affect the strains in another part."

The deep-seated reason for earthquakes remains a mystery to science. The most plausible theory, according to Prof. Lawson, is that deep in the earth the rocks, while remaining hard and very dense, act like a fluid and tend

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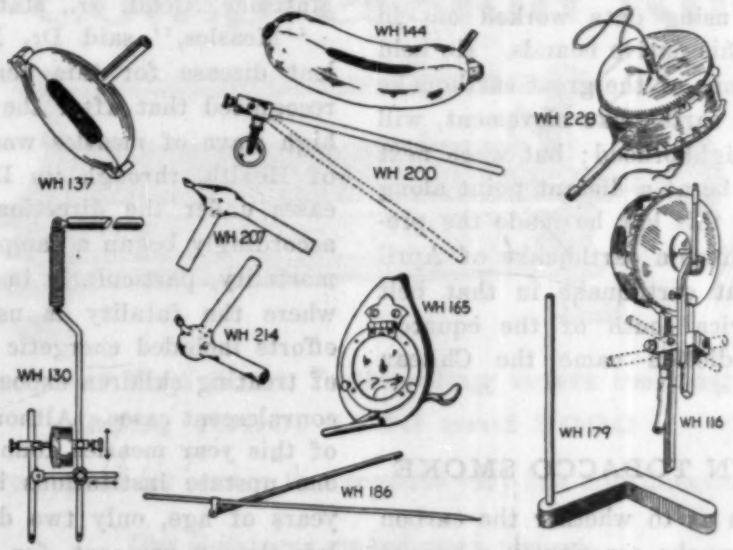

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to flow from one part of the earth to another, carrying the upper crust with them. The strains that produce earthquakes at the surface are caused by these deeper movements.

PREDICTION OF THE JAPANESE EARTHQUAKE

Science Service

THE recent devastating Japanese earthquake was predicted nearly two years ago, according to F. Tondorf, S.J., director of the Georgetown University Seismic Observatory at Washington. He pointed out that Prof. F. Omori, head of the Imperial Earthquake Investigation Committee of Japan, in March, 1922, forecast the occurrence of severe shocks within six years.

This prediction was based on the number of quakes in the years immediately preceding. The Japanese scientist noted that when earthquakes were many and often severe shocks were unlikely to follow, but when the small earth movements were relatively few and far between over a long period, earthquakes were liable to be more serious later. On account of the comparative absence of quakes preceding his forecast, Prof. Omori predicted that serious quakes would occur within a period of six years.

Through his study of rainfall in the northern part of the islands, he was able to point out an apparent connection between the precipitation and earthquakes, showing that when the rainfall was exceedingly heavy in this section it would be followed by earthquakes.

Omori believed that the primary cause of the earthquake is the breaking of the earth's crust, but that the cause of this break is the additional pressure furnished by the added weight of air and water as shown in rainfall and barometric measurements.

Prof. Omori also predicted the great Chilean earthquake of August 17, 1906, using data worked out in regard to the earthquakes of his native islands. He held that the stress applied along one of the great earthquake belts, on finding relief by an earthquake movement, will not for a time affect that neighborhood; but when next the stress finds relief, it will be at a distant point along the belt. Upon the basis of this law he made the prediction shortly after the California earthquake of April 18, 1906, that the next great earthquake in that belt would occur in South America south of the equator. Immediately after this prediction came the Chilean quake.

CARBON MONOXIDE IN TOBACCO SMOKE

THE much mooted question as to whether the carbon monoxide present in tobacco smoke constitutes a hazard to the smoker in confined indoor spaces seems to have been settled as a result of tests just completed by the Department of the Interior at the experiment station of the Bureau of Mines at Pittsburgh, which demonstrated the danger to be negligible.

The tests, which were performed in the course of general studies of the Bureau of Mines relative to gas hazards in mines, were made on three men confined in a closed chamber whose dimensions were 1,000 cubic feet. The three subjects puffed merrily for the space of an hour and a half at cigarettes of every variety, Turkish, Egyptian, the old Virginia brand, and the type wherein the smoker "rolls his own." Following this, the smokers drew energetically at an infinite variety of cigars—cheroots, Pittsburgh stogies, black Manilas and Havanas of choice degree. Finally they puffed frantically at pipes, at pipes of clay and cob, at pipes of meerschaum and briar. At the conclusion of the performance the air of the closed chamber had become so smoky that it was impossible to see across the room. The atmosphere was so irritating to the eyes that it was necessary to wear goggles.

Samples of the atmosphere and blood samples of the smokers were then taken for analysis. It was found that in no instance did the carbon monoxide content of air exceed 1/100 per cent. The maximum blood saturation was 5 per cent. Some of the subjects supposedly inhaled their smoke, but the tests indicated that such inhalation, though it may have extended to the bronchial tubes, did not penetrate throughout the lungs. The tests indicate that carbon monoxide hazard from smoking indoors or in mines is negligible in itself, though the Bureau of Mines investigators consider that it may add to the smoker's hazard should he be caught by carbon monoxide from sources such as occur in the mining industry.

CAUSES OF DEATH IN NEW YORK STATE

NEW low records for diphtheria and typhoid fever, contrasted with epidemic prevalence of measles yet with very low death rates for that disease and for scarlet fever were the outstanding features of a report on the communicable diseases of New York State exclusive of New York City for the first half of 1923, made public by Dr. Matthias Nicoll, Jr., state commissioner of health.

"Measles," said Dr. Nicoll, "was the most prevalent disease for this period. Early this year it was recognized that after the low records in recent years a high wave of measles was due. The State Department of Health, through its Division of Communicable Diseases under the direction of Dr. Edward S. Godfrey, accordingly began a campaign to keep down the measles mortality, particularly in institutions for small children where the fatality is usually extremely high. These efforts included energetic promotion of the new method of treating children exposed to measles with serum from convalescent cases. Although during the first five months of this year measles found entrance to twelve of forty-one upstate institutions harboring children under four years of age, only two deaths occurred in institutions, less than 2 per cent. for the period, as contrasted with 20 per cent. for 1922."

Up to July first of this year 36,663 cases of measles were reported to the State Department of Health as compared with 13,383 for the same period last year. Twenty per cent. of the 274 deaths this year were of children less than one year old, while sixty per cent. of the measles mortality was among children under three

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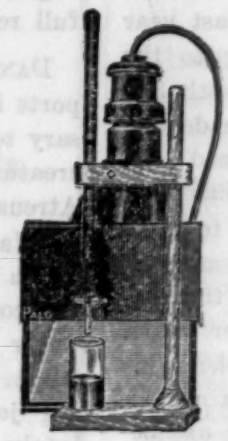

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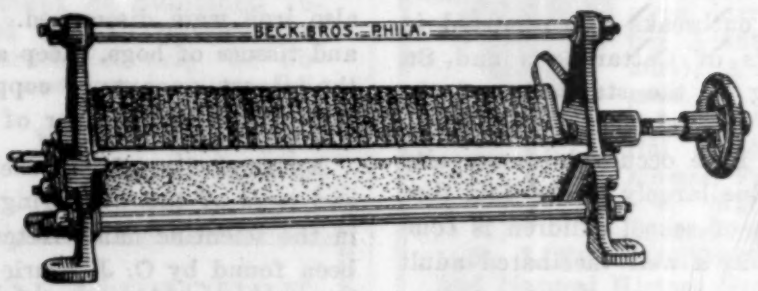

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years of age. The measles fatality rate this year was 75 deaths per 10,000 cases as compared with 95 in 1923 and 90 for the average during the last five years.

Diphtheria showed 2,819 cases for the first half of this year as against 4,030 for the same period last year and 4,365 for the five year average, according to the report. There were but 221 deaths compared with 310 last year and a five year average of 367. "The decline in diphtheria is especially encouraging," said Dr. Nicoll. "Since 1916 the diphtheria death rate has been higher each year than the average from 1912 to 1916 despite all the efforts of local and state health authorities. While the record for last year was better the rate still failed to drop to the level of these earlier years. The outlook from the figures so far this year leads us to believe that the Schick test and toxin antitoxin campaigns begun last year and intensified this year are beginning to show very definite effects. The incidental education of the public has been perhaps even a more potent factor in the reduction than the active immunization of susceptible children.

"There were twenty fewer cases and eight fewer deaths from typhoid fever during the first six months of this year than were ever previously recorded for the period. But since about two thirds of the annual total of typhoid cases ordinarily occur during the first half of the year, we feel that the gratifying record so far should be taken as an incentive to greater effort to keep down this disease for the rest of the year."

Scarlet fever with 7,634 cases was more prevalent than ever before recorded for this period, the repora said, but the mortality of 105 cases was the lowest since 1919 and gives a fatality rate of only 1.4 per cent., which is the lowest on record for this disease. Whooping cough was also more prevalent than in 1922. There were 218 cases of smallpox as compared with 88 last year and with a five year average of 262.

Most of the cases of smallpox were reported from Niagara Falls and vicinity with Jamestown and Olean next in order, though small outbreaks also occurred in Dunkirk and the rural parts of Cattaraugus and St. Lawrence counties, according to the statement of the department. "It should be noticed," said Dr. Nicoll, "that no cases of smallpox have occurred in any city of the first or second class, due largely to the fact that in such cities the vaccination of school children is compulsory, resulting eventually in a well vaccinated adult population."

ITEMS

Science Service

THE volcanic activity reported in news dispatches as accompanying the Japanese earthquake must be considered secondary to the great "tectonic" or structural disturbance in the earth's crust that has taken place, Dr. H. O. Wood, in charge of the California seismologic investigations of the Carnegie Institution, said in response to an inquiry from *Science Service*. He declared that there is no knowledge regarding the relation of this disturbance to other regions. "No scientific investigation of the disaster is contemplated by American scientists," he said, "since the Japanese Imperial Earthquake Investigation Committee is splendidly equipped and thoroughly competent to study the occurrence and make a full report."

DANGER and delay to steamships under way in Red Sea ports is caused by large jelly fish and it is often necessary to send down divers to cope with these tropical sea creatures, W. Postlethwaite, 2nd officer of the "S. S. Atreus," reports to the Hydrographic Office of the U. S. Navy Department. He recommends a method by which ship masters can avoid the trouble occasioned by the complete choking of the intake of the ship's main water supply system by these simple jelly-like forms. Water for the boilers is completely cut off when these big jelly fish are drawn against the grating over the intake by the main suction pump. In order to cause no risk or delay to the vessel while under way so close to land, he advises that, while the ship is at anchor in these ports, water be taken through the pump which is designed to regulate the water ballast in the hold of the ship and through which the water can be pumped either into or out of the ship. By pumping back, the jelly fish can then be forced off the intake grating without the necessity of sending down a diver to clear it off.

EXPERIMENTS now under way may show that compounds of copper, manganese and zinc, found closely associated with the so-called vitamins in animal and plant tissue, are essential to life, Prof. J. S. McHargue, research chemist of the Kentucky Experiment Station, told the American Chemical Society. Prof. McHargue reported having found appreciable amounts of lead, arsenic, copper, cadmium, manganese, zinc, nickel and cobalt in virgin and cultivated soils from three different geological formations in Kentucky. Plants and seeds growing under natural conditions were also examined and copper, manganese and zinc were found in all cases. In wheat, corn and rice, these three elements and also iron were discovered. The more important organs and tissues of hogs, sheep and cattle were examined and the largest amounts of copper, manganese, zinc and iron were found in the liver of each of these animals.

AFTER eluding all searchers for over sixty years, a nest and eggs of the wandering tattler, a sea bird rejoicing in the scientific name Heteroscelus incanus, have at last been found by O. J. Murie of the U. S. Biological Survey, Department of Agriculture, in the Savage River region of Alaska. The nest and four eggs nave been sent to Washington, where they were transferred to the U. S. National Museum for permanent preservation. Dr. C. W. Richmond, associate curator of birds in the museum, said that the "Wandering Tattler was discovered in Polynesia on one of Cook's voyages, and has since been found on many islands of the Pacific, but always as non-breeding birds. For many years it has been known to occur on our west coast and in Alaska, where it was thought to nest. Many expeditions there in the last sixty years or so have been on the lookout for the nestband eggs of this species, but without success until the present."

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SCIENCE NEWS

RADIO AIDS TO NAVIGATION ON THE PACIFIC COAST

Science Service

THE Pacific coast is deficient in radio aids to navigation, officials of both the Navy Department and the Lighthouse Service agreed when questioned concerning possible causes for the recent wreck of seven U. S. destroyers and the Pacific Mail S. S. *Cuba* near Point Arguello, California.

Investigation has brought out the fact that neither radio beacons nor radio compass stations have been installed anywhere on the long stretch of dangerous coast between San Francisco and Pt. Arguello, along which the destroyers were traveling. There is a radio compass at Pt. Arguello lighthouse and another farther down the coast at Pt. Hueneme, but bearings from two stations are needed to give a navigator his position and only the first named station was available to those on the wrecked ships.

There are two types of radio aids to navigators, the radio compass, operated by the Navy Department, and the radio beacon, operated by the Lighthouse Service. The radio compass stations are equipped to give the commander of a vessel at sea his compass bearing from the station in question. If such bearings from two stations can be obtained the position of the vessel may be accurately ascertained. The bearing is worked out by the land operator.

The radio beacon operates on a different principle. Radio signals are sent out broadcast in all directions at frequent intervals. Vessels are equipped with radio "direction finders" which enable them to locate the bearing of the sending station. If the bearings of two stations can be had the ship's position can be worked out.

Each system has its advocates. The Navy Department favors the radio compass because it asserts that it is more accurate for the determination of bearings to be made by experts ashore who do nothing else, than by radio officers on shipboard who have many other distracting duties. Lighthouse officials favor the radio beacon with the direction finder on the ship, as they assert it is best to have the responsibility for the ship's position fixed on board the vessel and not by some one ashore. The direction finder for use in connection with radio beacons has already been adopted by many of the large transatlantic and eastern passenger lines, and by the Standard Oil Company for the equipment of its tank steamers.

Only two radio beacons are at present in operation on the Pacific Coast. These are on lightships off San Francisco and off the mouth of the Columbia River. Radio compass stations are more frequent but there are none between San Francisco and Pt. Arguello.

Little credence is given by government experts to the theory that the wrecks may have been caused by a current set up by an earthquake under the sea, or by the remoter ones in Japan. Such a thing is considered possible but unlikely. All unite, however, in the need of better radio protection to shipping along the western coast.

EARTHQUAKE-PROOF HOUSES

Science Service

MAN, and not nature, is to blame for the disastrous consequences of earthquakes in such localities as Japan, Chile or California, in the opinion of Dr. Bailey Willis, one of America's leading geologists, who has just returned from Chile where he traced the earthquake of last November to its lair high in the Andes.

Referring to his investigations in Chile as a representative of the Carnegie Institution of Washington, Dr. Willis said to *Science Service*: "When it came to the point of a verdict which should place the chief responsibility for the disaster upon the right shoulders, we could not convict the earthquakes. Where Nature gives warning after warning, but man remains heedless, he has but himself to blame for the consequences. So it was in Chile, so it is in Japan, and so it will be in California or wherever else earthquake risk is carelessly disregarded."

Dr. Willis is professor emeritus of geology at Stanford University and he declared that he is a good Californian except that he is inclined to take earthquakes seriously. Dr. Willis explains how earthquake-proof houses may be built and he also relates his experiences in addressing the population of the town of Vallenar in Chile, badly damaged by last year's earthquake. He said: The mayor of Vallenar invited me to meet a group of gentlemen in the Union Club to talk to them about earthquakes. The president of the local workingmen's union desired a more public discussion and the mayor yielded the point. The meeting was held in a temporary theater with a capacity for about 400 people and it was crowded. In front sat a group of officials, the priest, and the landowners. To the number of fifty they represented that portion of the audience which could read, write and cipher. The workmen were there in force, few of them wearing anything more than shirt and trousers. There were many women, their dark faces stamped with resignation and half hidden in the black mantillas. Young girls, youths and street urchins were scattered among their elders and some of the last looked down from perches in the rafters I have spoken to many audiences, but not to any that was more responsive or attentive. This was for them no academic discussion. The earthquake had been a terrible experience and before them was a man who was supposed to know how to guard against a repetition of disaster in Vallenar, or whether they must abandon their city and move to another site, as was proposed.

No one of any feeling could look into those dark, sad faces and not realize how urgent is the solution of the

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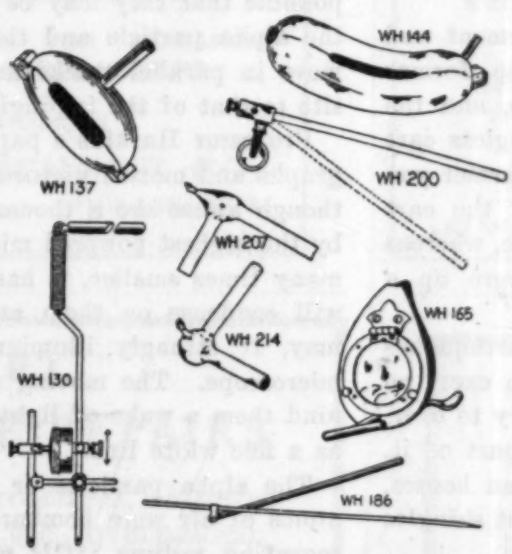

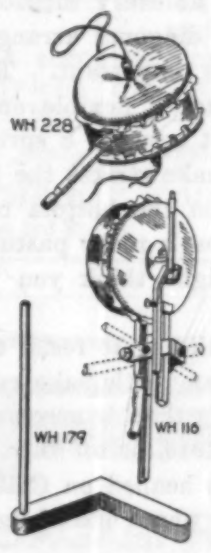

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problem of safeguarding the people of earthquake zones from danger. In the presence of that audience it became an immediate obligation to study the causes of failure of the houses as they had been built and to discover methods of building safely with the materials and workmanship at hand.

To construct a house that will withstand an earthquake is not difficult if you can command the right materials and good carpenters, but during three hundred years it has proved to be more than the unskilled artisans of Chile could do, handicapped, as they have been by poor wood, wretched mortar, and the evil inheritance of adobe buildings. They used to put together structures that were pinned with wooden pins and tied with rawhide, which were both strong and elastic. Some of them have passed through the earthquakes of the past century without serious damage. The introduction of iron nails, which are so easily driven, appear to hold so well, but in fact pull out with ease, has resulted in much weaker frames, that are quite unequal to the task of upholding the heavy walls and roofs of adobe. Back to the good old joinery should be the cry. Rawhide should be used if convenience and cheapness require, but galvanized fencewire is better when skillfully stretched or tied. And adobe should be used only to fill thin walls, never in heavy masses.

An American frame house, well mortised and pinned, is as safe as reinforced concrete, provided the lath is replaced by fence wire on both the inside and outside of the frame. The wire can be put on in either one of two ways, parallel with both diagonals or parallel with the beams and uprights, and it should be spaced from 3 to 6 inches apart, according to the size of the wall and the quality of the plaster. It must be stretched tightly to form a firm network to which the plaster can adhere and for this reason wire netting does not do as well, because it can not be drawn as tightly as a continuous strand, which is fastened by staples at every turn.

The difference between the diagonal arrangement and the horizontal-vertical one is important. The former makes a rigid house, the latter a flexible one, and the distinction is the same as that between a springless cart and a carriage. When the quake strikes the former you will feel like a man lying on the bottom of the cart while the team runs away across a rocky pasture, whereas in the flexible house you might think you were up a tree.

There is one thing about building to resist earthquakes that people seem to forget: an earthquake can exert no more force to wreck a building than is necessary to overcome the inertia of the structure, or of some part of it. A heavy mud-roof, such as is heaped on Chilian houses, will wrack and ruin the walls, where one of light shingles would sway with them.

Another point which has not been recognized generally by architects or engineers is that it is the earth which moves, while the house tries to stand still. If you could put a ball-bearing between your house and its foundations, instead of bolting it to them, you would not have to buy your wife a new dinner set. This idea is embodied in every instrument for recording earthquakes and was applied many years ago by Sir John Milne to the construction of a lighthouse in Japan. I have recently recommended its consideration by a firm which is contemplating the building of a warehouse on dangerous ground in Valparaiso, Chile, and I believe it can be introduced successfully in some combination of bearings, springs or shock absorbers. For the ordinary house a broad ditch packed with cobblestones on which there rests a well-braced frame of heavy beams would not be a bad substitute. It would allow the ground to slide under the house, which could be jacked back into position with reference to such unstable things as trees, garden walks and roads, at your convenience.

These ideas about building quake-proof houses grew by degrees as I studied not only the ruins, but also the surviving buildings. The evidence was a liberal education in how to build and how not to, and the conclusions will be published by the Carnegie Institution of Washington as a contribution to the safety of the Chilian people or of others who may be similarly circumstanced.

ZETA RAYS

Science Service

DISCOVERY of a new and rare sort of rays resulting from partial disintegration of atoms as a result of collisions with alpha particles, the nuclei of helium atoms, moving at a speed 30,000 times faster than a rifle bullet, was announced to the American Chemical Society meeting at Milwaukee on September 12 by Professor W. D. Harkins and R. W. Ryan, of the University of Chicago. The discovery was made as the result of 41,000 photographs of atomic collisions.

The new rays, which have been named "Zeta rays" by Professor Harkins, are very short and are thought to be due to electrons knocked out of atoms through which the flying alpha particle speeds. He also considers it possible that they may be due to electrons picked up by the alpha particle and then discharged from it. They move in parallel tracks and in a direction nearly opposite to that of the impinging alpha particle.

Professor Harkins's paper was illustrated with photographs and motion pictures of the atomic collisions. Although atoms are a thousand times too small to be seen by the highest powered microscopes and the electrons are many times smaller, it has been found that water vapor will condense on them and that these minute droplets may, if strongly illuminated, be made visible in the microscope. The moving nuclei and rays thus leave behind them a wake of light which appears in the pictures as a fine white line.

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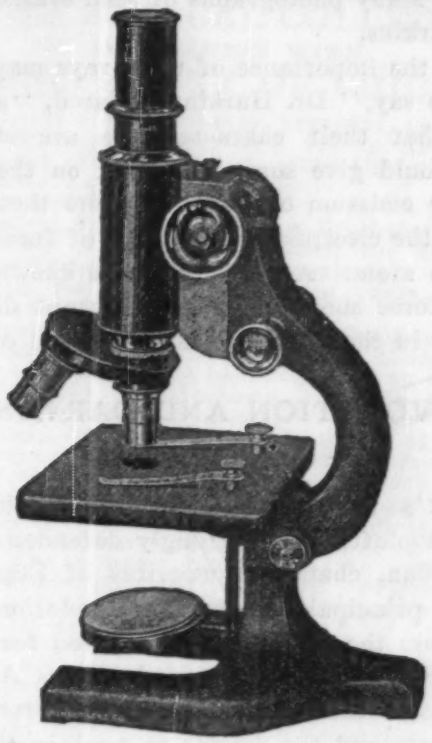

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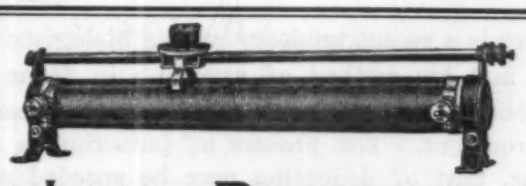

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rare. When this happens the atom is smashed up beyond recovery. Many photographs of such crashes were shown by Dr. Harkins.

"What the importance of these rays may be, it is impossible to say," Dr. Harkins declared, "since they are so new that their characteristics are still unknown. "They should give some new light on the structure of atoms, the emission of electrons from them, and of the nature of the electromagnetic fields of force in the vicinity of the atom. A more thorough knowledge of these fields of force should lead to important discoveries and inventions in the fields of chemistry and of physics."

EVOLUTION AND DARWINISM

Science Service

DARWIN'S methods and general conclusions in the study of evolution were strongly defended by Dr. David Starr Jordan, chancellor emeritus of Stanford University, in a principal address on "Evolution and Darwinism" before the American Association for the Advancement of Science now assembled in Los Angeles for its fall meeting. Modern naturalists are forsaking the seas, the meadows and the forests to work in the greenhouse, Dr. Jordan declared, urging a broad and universal outlook upon all facts before making generalizations. "They will find their way back," he stated. "The apparent eclipse of Darwinism to-day is wholly transitory."

Dr. Jordan said in part: "Nothing we know of takes place without an adequate cause. Among the attempts to search for causes for phenomena in animal and plant life, the most notable have been those of Lamarck and Darwin. Lamarck noted the facts of use and disuse in the development and modification of the individual, and suggested that the higher groups must have originated in like fashion. Hence the theory of development through the inheritance of acquired characters, hereditary traits being modified from generation to generation through use and disuse of organs or through 'the slow willing of animals.'

"Darwin went much farther, stressing especially the sifting and splitting due to varying environment. These he summed up under the complex term of 'Natural Selection.' He conceived of a 'struggle for existence' with the continued survival of those which could maintain themselves, bequeathing their adaptive characters to their progeny.

"There is a recent tendency among biologists to ignore Darwin and his method of approach in favor of more metaphysical conceptions of evolution, as unconditioned by environment. The process of induction is slow and laborious, that of deduction may be speeded up as demanded. The basal fact remains, the method of Darwin of considering *all* relevant truths is the only way. Partial or deductive conclusions can only lead to the state of mind of unshaken belief in evolution and 'agnosticism' as to its 'causes.' But the causes are the matters really important."

After emphasizing that the descent of living forms from series now extinct is too obvious for any well-informed mind to question, Dr. Jordan continued:

"We would like to know how this came about. Darwin's work is like a great sketch map which his successors are filling in and in no vital respect will the final chart vary from the ascribed landmarks. Naturalists have found that they can produce in a few weeks by selection and segregation forms apparently as distinct as Nature can establish through similar means in a millennium. But Nature's species are of long endurance and the reason why this is so is a vital part of our problem.

"We know nothing of evolution in vacuo, of change in life unrelated to environment. All forms of life are split up into species with adaptation to external conditions visible in every structure. We know of no way in which organisms become adapted to special conditions except by the progressive failures of those which do not fit. No organism has escaped or can escape the grasp of selection.

"To admit these facts and yet say that selection and segregation are not factors in evolution would appear to make the matter a mere question of words. If by evolution we mean the theoretical progress of life, due solely to forces intrinsic in organisms, then outside influences are of course not factors in such evolution. If, however, we mean the actual movements of actual organisms on this actual earth, then extrinsic influences and obstacles are factors in continuous, diverging change."

ITEMS

Science Service

ONLY one commercial white bread and no whole wheat bread of many examined, according to Professor Worth Hale of the Harvard Medical School in an address to members of the American Chemical Society at Milwaukee, is adequate for the growth and maintenance of growing children. Experimental white breads made with the addition of the water extract of wheat embryo and with a small percentage of milk proved far superior to the average white or whole wheat bread. The consumption of wheat products in the United States was declared by Dr. Hale to have risen from 5.3 bushels *per capita* in 1915 to 5.8 bushels in 1920.

GERMS can now be dissected and handled under the microscope, according to a report sent to the American Medical Association by its Budapest correspondent. Dr. Tibor Peterfi of that city has demonstrated to a medical society a device with which an investigator can grasp bacilli and cut them with glass and platinum needles. This is expected to result in new physical and chemical investigations.

GREATER output of coal and less fatigue to miners is claimed as the result of a psychological investigation of the best way to use a pick recently made in Manchester, England.

A NEW insect pest, the Australian tomato weevil, has been recently discovered in the South and agricultural experts fear it may become of great importance in the United States unless promptly suppressed.

IN a recent free balloon race, the winning aeronauts kept track of the location of their competitors by means of radio reports received by apparatus installed in the basket of their balloon.

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SCIENCE NEWS

THE JULIAN CALENDAR

Science Service

MILLIONS of people who go peacefully to bed the night of September 30, according to their calendar, will "lose" 13 days before daylight comes next morning. The next day for them will be October 14, the beginning of the shortest month of their lives. Such is a result of the decrees of the "Pan-Orthodox Congress" of the various branches of the Eastern Orthodox Church at a meeting last spring, fixing a time for the final abandonment of the Julian Calendar which was for 1,600 years that of the Roman empire and of the entire Christian world and which in parts of the world has endured to this day. The change will occur at midnight, October 13, on our common or Gregorian calendar.

Julius Caesar was not a man with a great reverence for ancient customs just because they were old-fashioned. In his day the old Roman calendar had become so inaccurate that it was three months ahead of the sun; when the calendar said it was summer, the sun said it was spring, and festivals fixed by the calendar came at inappropriate times. Julius proceeded to do something about it. He called in Greek and Egyptian astronomers, and established the calendar that bears his name.

The old year had been just 365 days, but the astronomers found that the error in the calendar was due to the fact that the year as measured by the time between two successive nerval equinoxes, or the moment when the sun crosses the celestial equator on its way north, was something longer than this, or about 365 days and six hours. So Caesar invented the Leap Year, adding an extra day every four years and thought the problem solved.

But astronomical science progressed, even during the so-called Dark Ages after the fall of Rome, and by the latter part of the sixteenth century when it was recognized there was a difference of some 10 days between the sun and the calendar, the remedy was also recognized. Pope Gregory XIII called a council of astronomers who, knowing the amount of the error in the method of the Julian Calendar, proceeded to correct it by eliminating one leap year at the end of every century except those for the years evenly divisible by 400. According to this rule 1900 was not a leap year, but 2000 will be.

The Gregorian Calendar was immediately adopted by the Roman Catholic world, but since the adoption of the Julian Calendar the Eastern churches had split away from Rome and acknowledged no allegiance to the Pope, while at the same time the Protestant Reformation was in progress in western Europe and for a long time the Protestant nations stuck to the old reckoning.

England, however, finally adopted the Gregorian calendar in 1752 and it became effective in the American colonies about the same time. The error in the Julian calendar was then 11 days and the day following, September 2, 1752, was called September 14. But the several branches of the Eastern Church and the nations where it was the dominant religion kept to the old calendar. Russia was the first to break away, the Soviet government adopting the western calendar in 1918; Roumania and Serbia followed in 1919. Among the nations outside of Christendom, Japan, China and Turkey had already followed the lead of the western world, leaving Bulgaria and Greece and the Greek Orthodox Church as the only adherents to the older system.

But where that church is strong, as in Russia and Roumania, there have been two calendars in operation, the religious and the civil, resulting in much confusion. It even affected vitally American industries which employed Eastern Europeans, since pious Orthodox workmen insisted on observing holidays for a second time, when the belated Julian calendar caught up with our own. This will end next month, and for the first time since 1582 the entire civilized world will be keeping the same time with one notable exception. The Ruthenian Catholics, or Uniates, as they are known in Europe, a body of Christians numbering some 8,000,000, of whom half a million are in this country, will still adhere to the astronomy of Julius Caesar. They dwell chiefly in the Russians Ukraine and in neighboring regions, and although they acknowledge the spiritual supremacy of the Roman church they dislike their Greek and Roman Catholic neighbors so heartily that they will not even have the same calendar and the same festival days as they do.

How long they will hold out is a problem; but as things are it seems that the Julian Calendar is doomed to ultimate extinction after having lasted some 1,962 years.

THE EINSTEIN THEORY

Science Service

CONFIRMATION of the third prediction of Einstein resulting from the application of his general theory of relativity was announced to the American Association for the Advancement of Science at its recent fall meeting at Los Angeles by Professor Charles E. St. John, of the astronomical staff of Mt. Wilson Observatory. The lines of the solar spectrum are not identical in position with those due to incandescent samples of the same elements when observed on the earth, and the displacement is toward the red end of the spectrum. This indicates a slowing up of the rate of atomic vibration, as predicted by Einstein, as a result of the difference of the position of the two samples of incandescent elements with reference to the gravitational field of the sun.

Einstein has stated that his theory of relativity stands or falls according to whether or not this effect is observed. Professor St. John has calculated that the displacements of the lines in the solar spectrum predicted by Einstein amount to 86 per cent. of the total observed effect, the remainder being due to other well-known effects resulting from conditions in the solar and terrestrial atmospheres and to the sun's rotation on its axis.

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Dr. St. John considers as proved the main prediction of Einstein, that in the vicinity of the center of the gravitational field of the sun the rate of vibration of atoms is slowed up as compared with their rate of vibration when as far away from the sun as is the earth.

The other two Einstein predictions which have already been verified are the distortion of the orbits of the planets around the sun which was soon confirmed in the case of Mercury; and the more famous one of the deviation of light rays by the action of the gravitational field of the sun when passing close to that orb. This last has been confirmed by several observations taken at the last two solar eclipses of the sun. Dr. St. John's announcement completes the list of Einstein's predictions, all of which have been verified.

CEREAL DIET

Science Service

"THE most important dietary problem confronting civilized man to-day is that of restoring the balance of essential nutrients which has been disturbed by the prevailing use of cereal products," the subcommittee on animal nutrition of the National Research Council declares in a report published here in which they outline leading research problems awaiting solution.

Pointing out that human beings will always consume large amounts of cereal foods, they urge investigation to determine the proper place of animal foods in human diet in infancy, childhood, maturity, reproduction, senescence, sickness, labor, war and sedentary life.

"This group of problems in practical human dietetics has always been and always will be," they say. "We have reached an age, however, in which progress in their solution is possible at rates vastly greater than in any earlier era; and these great problems must be kept constantly before research men in order that no opportunity may be overlooked for contributing to their solution through the undertaking of definite projects of properly limited scope."

The necessary laboratories, groups of competent investigators and institutions of various sorts providing satisfactory groups of experimental subjects, are not uncommon but men who are able and interested to organize and to conduct such investigations and who can command the necessary human cooperation are rare.

Among the other general problems outlined in the report are the establishment of a scientific basis for judging farm animals, estimation of the metabolic nitrogen as a contribution to the perfection of feeding standards, mineral and vitamin requirements of farm animals, and the effect of diet on reproduction.

The sub-committee offers its cooperation to any who may desire it in the making of detailed plans for investigations in any of the fields suggested. The statement is signed by E. B. Forbes, State College, Pennsylvania; H. S. Gridley, Urbana, Illinois; F. B. Morrison, Madison, Wisconsin; C. H. Eckles, University Farm, St. Paul, Minnesota, and C. R. Moulton, 509 South Wabash Ave., Chicago, Illinois.

CANCER RESEARCH

Science Service

AN experiment that may explain the essential nature of cancer has been announced by the Imperial Cancer Research Fund in London, according to information reaching the American Medical Association at Chicago. It was found that cells from cancerous growths will grow outside the body if they are planted in a suitable medium, but that ordinary body cells such as those in the kidney will grow only after they have been removed from the body for several weeks. But the ordinary cells were found to grow immediately if some of the extract in which a tumor is growing is added to the ordinary well cells. The British scientists argued from this that cancer cells automatically and continuously produce substances which activate growth and that normal cells produce these substances only when injured.

Long continued irritation of tissues may produce cancer, past experience has shown, and the findings of the British scientists explain and is in accord with this fact. Vitamin deficiency has nothing to do with the growth of cancer the announcement also stated on the strength of extensive researches.

THE SENSE OF COLOR OF BEES

Science Service

BEES are color blind as people sometimes are, and they learn their way about by experience rather than by instinct. These are some of the conclusions reached by Professors F. Frisch and Lothar Tirala, German biologists, who have made a careful study of the insects. They have shown that to the bee, red and black look alike, orange and yellow look the same as green, and there is no difference in the appearance of blue, violet and purple. But they have one advantage over man; they can see the rays of ultraviolet light, which are invisible to our eyes.

It was also discovered that the mysterious guiding influence by which the bee is brought back to its hive is nothing more than experience. It has long been known that bees find their way home sooner the longer they have lived in their hive. So some bees were put to sleep by ether, taken from a new hive and moved some twelve yards away. None of them could find their way back to the hive until the third day afterward, when 30 per cent. got home. By the eighth day, 90 per cent. of them had learned.

FOOTPRINTS IN THE SANDS OF TIME

Science Service

STRANGE three-toed tracks found in blocks of sandstone quarried to make a walk in front of the former home of President James Monroe at "Oak Hill" near Aldie, Loudoun County, Va., have been declared by scientists to be the footprints made in the sand by a gigantic reptilian dinosaur fifteen million years ago.

While dinosaurs are chiefly known from reconstruction of fossil bones found in the western states where these prehistoric creatures were apparently most abundant,

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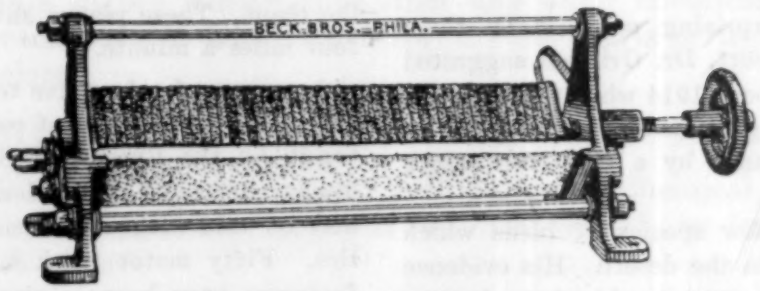

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many tracks of these creatures have been found in eastern states before, although few remains of the fossil reptiles themselves have yet come to light in the East.

The first evidence of dinosaurs was turned up by a farmer's plow in Connecticut in 1802, and was in the form of impressions similar to the footprints in the sands of geologic time just unearthed near Leesburg. At that time these mysterious tracks were thought to belong to some unknown bird and became known as the tracks of Noah's raven. Later investigation and the finding of skeletal remains of the dinosaurs in the West in 1870 showed that extinct reptiles of gigantic size had made them.

The findings of these fossils where President Monroe once lived, has recalled to historians there that Thomas Jefferson, another president from Virginia and a close personal and political friend of Monroe's, was one of this country's earliest fossil hunters and himself discovered what he termed Megalonyx, or "The Great Claw," a prehistoric Giant Sloth which lived hundreds of thousands of years ago but several million years later than the dinosaurs.

ENGLISH SPARROWS IN DEATH VALLEY

Science Service

ENGLISH sparrows have made their home in Death Valley, ornithologists of the American Association for the Advancement of Science were told in an address at Los Angeles by Dr. Joseph Grinnell, professor of zoology of the University of California, in which he gave the results of the bird census taken by him in the below-sea-level portions of that desert. This sparrow colony, established in the 60-acre oasis at Furnace Creek Ranch surrounded by a vast desert of extreme type, furnishes an extremely interesting "experiment in nature," he declared, and explained that if it persists it will show how soon, if at all, the color and markings of the birds will be affected by the extreme climatic conditions of their environment.

In accounting for the surprising presence of these nonmigratory birds in the desert, Dr. Grinnell suggested that they probably came in about 1914 when the Tonopah and Tidewater Railroad was constructed to Ryan, which is only 17 miles from the ranch by a road over which more or less teaming is done.

Sparrows are one of the few species of birds which Dr. Grinnell found breeding in the desert. His evidence indicates that sparrows nest late in this hot climate. This is contrary to the theory that it is a certain amount of heat that starts breeding; as it is hotter at Furnace Creek Ranch in April than it is in July in west-central California where sparrows nest generally by April 1.

Most of the 124 species of birds which have been found in Death Valley are migratory.

"As is well known," said Dr. Grinnell, "migration comes to human attention chiefly through notice of the birds which stop over on the way. We do not ordinarily see the birds in actual passage. Death Valley is a north-and-south trough between high mountain ranges, the Amargosa Range on the east, 4,000 to 7,000 feet high, and the Panamint Range to the west, 5,000 to 11,000 feet high. The valley forms a natural channel for through migration. Thus Furnace Creek Ranch is a natural lodestone, pulling to itself now and then from the migrant stream, individuals or flocks, day or night, and these may loiter a few minutes or a few hours, or even a few days, before resuming their journey. Again and again I had the experience of seeing bands of swallows, which migrate by day not far from ground, arrive from the south, wheel a few times over the alfalfa and then make off northwards."

If Furnace Creek Ranch could be made the base for continuous observations of birds throughout the entire year for a series of years, quite as startling and significant findings would result as have resulted from the migration studies on the island of Heligoland of the North Sea.

ITEMS

Science Service

DEFINITE information as to changes in Yokohama harbor due to the earthquake has been received by the U. S. Hydrographic Office from the master of the American steamer President Jefferson which recently arrived at that port. The inner harbor is now impracticable for deep draught vessels as the bottom has changed and there is less depth. The breakwater is broken and sunk, and cargo can be discharged only into lighters from anchorage outside. Out of 11 lighthouses in and around the harbor only three were reported in order; three had completely collapsed; the others were standing but not in operation.

THE U. S. Navy has developed four planes for entry in the Pulitzer Race at St. Louis on October 3 that have shown unprecedented high speeds in preliminary flights. Two navy Wright fighters, powered with Wright T-2 engines that have developed 700 horsepower in flight tests, and two Navy Curtiss racers, powered with Curtiss D-12 engines, that have shown 500 horsepower, comprise the team. These planes have been driven at speeds over four miles a minute.

A SERIES of exhaustive tests on the wearing quality of automobile tires made of reclaimed rubber is about to be begun by the Bureau of Standards for the purpose of discovering what proportion, if any, of reclaimed rubber may be used without reducing the wearing quality of the tire. Fifty motor truck tires made to order by manufacturers have been received at the bureau and will be used in these tests. The tires are made in four equal sectors, each of which will have equal wear. The proportion of reclaimed rubber to the total amount of rubber used is respectively zero, 10, 18 and 25 per cent. Forty of these tires are to be fitted to Post Office trucks and their wearing quality observed in road service. The other ten will be tested on the apparatus now in use at the bureau for that purpose and on new apparatus designed to approximate road conditions even more closely.

SUBTERRANEAN disturbances in Hawaii have caused the surface of the Lake of Living Fire of the Kilauea volcano to drop 600 feet below the rim, radio reports state.

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SCIENCE NEWS

A PERMANENT NEW STAR

Science Service

THE remarkable new star in the constellation of the Serpent, which unexpectedly rose from obscurity fourteen years ago, still maintains its brightness and thereby justifies for it the title of the "only genuine new star," according to stellar photographs recently made at the Harvard College Observatory. The stars ordinarily called "new" by astronomers are really but temporary affairs that fade away rapidly within a few days or weeks after their sudden appearance.

This interesting object, which has been given the name RT Serpentis, was originally discovered by an astronomer at Heidelberg, and later quite independently at the Yerkes Observatory in Wisconsin. It was, however, on record earlier, for a subsequent examination of the store of celestial photographs at Harvard showed the star coming out of darkness nearly a year before its discovery by the German astronomer. For twenty years before that time the Harvard plates give no trace of it.

RT Serpentis was first classed as one of the Novae, or "new" stars, and it also was expected to fade away as all of them have done in the past. But this object proved to be an exceptional phenomenon. It has now maintained its maximum brightness at the tenth magnitude for thirteen years. Measures of the parallax show that its distance is about one thousand light-years.

Scientists have not yet explained satisfactorily the singular behavior of RT Serpentis. Three possible interpretations, however, have been suggested by Dr. Harlow Shapley, director of the observatory.

Could this actually be a new star evolving from a nonluminous and nebulous beginning? A star birth has indeed never been witnessed, and it is not known in what manner stars first become luminous. RT Serpentis already shows signs in its spectrum which indicate that it is well along in its life history; but perhaps for stars of certain size some of the early evolutionary stages are lived through with great rapidity, and this star's birth was actually witnessed in 1909.

The second suggestion is that RT Serpentis is only a variable star of large range in brightness, with a very long interval of time between successive appearances. This explanation would require that sooner or later the star will again decrease in brightness, possibly to return to its present magnitude in some other generation.

The third suggestion proposed, and the one that Dr. Shapley thinks most probable, is that RT Serpentis is an ordinary unvarying star that has recently emerged from behind some obscuring cloud of cosmic dust. Many dark nebulous clouds are known to exist in the Milky Way, some of them at no great angular distance from RT Serpentis. Photographs of the region have been made, and all the stars nearby have been catalogued. If at some future time another star in this region should come or go, the existence of an obscuring cloud may be accepted as very probable.

FLYING AT HIGH ALTITUDES

Science Service

BY using a new device which feeds his engine air at normal sea-level density, Lieutenant John A. Macready, of the U. S. Army Air Service, will attempt within the next few weeks a rise to atmospheric heights rarer than those ever reached by man. The new equipment is now being installed on his plane at McCook Field. Lieutenant Macready was holder of the world's altitude record of 34,509 feet until two weeks ago when Sadi LePointe, a French aviator, was officially recognized as world champion with a record of 35,178 feet.

The "ceiling" for an ordinary airplane is about 21,000 feet, because the air above that is too rare to support combustion in the engine. In establishing his present record, Lieutenant Macready made use of a supercharger which supplied his engine with the necessary oxygen by compressing the rarified upper air through which the plane climbed. The much more efficient device, designed and built by the General Electric Company, which is now being placed on the plane, should feed atmospheric pressure to the engine at 35,000 feet.

This supercharge is mounted just back of the propeller blade of the plane on the front end of the liberty motor. It is operated from the motor's red hot exhaust, which ordinarily goes to waste. Its weight of about 140 pounds will cause a small loss of speed at the low altitudes, but will produce a decided gain in power at 35,000 feet equal to about two horsepower for each additional pound carried.

The pressure of the atmosphere at an altitude of 35,000 feet is about one fourth that at sea level. The temperature is 58 degrees Fahrenheit below zero. To supply the airplane engine its normal air at sea-level pressure, the supercharger is designed to compress about 2,200 cubic feet of atmosphere per minute. The new supercharger has a rated speed of 33,000 revolutions per minute, but in tests at the Lynn Works of the General Electric Company, it was operated up to 41,000 revolutions per minute, or 683 turns of the compressor wheel a second, a speed greater than ever before developed by a commercial machine.

To better visualize what such speed means, Dr. S. A. Moss, engineer, who designed the supercharger, has figured out that if any small object were placed at the outer end of one of the small revolving propeller blades it would travel 1,880 feet per second, or about three fourths the speed of a bullet from an army rifle.

Any object revolving at this terrific speed has an enormous centrifugal pull, and Dr. Moss in tests has determined that if a one pound weight, with its center of gravity located at the center of gravity of the supercharger blades, was revolved at 41,000 revolutions per minute its centrifugal force would be 222,000 pounds, or 111 tons. The blade of the machine, however, weighs but nine thousandths of a pound and the centrifugal

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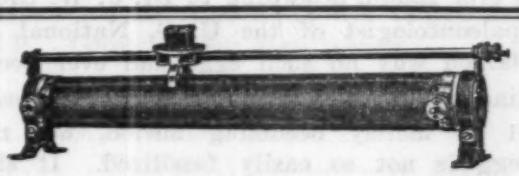

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About commencement time, June, 1923, a Leitz research petrographic microscope (practically new) disappeared from the petrographic laboratory at the University of Oregon. This microscope carries the following descriptive symbol: "SM" No. 0 No. 209681. Only one eye-piece and one objective were taken with it. All other accessories were lett. Anyone having any information as to an instrument answering this description will please communicate with

WARREN D. SMITH,
Department of Geology, University of Oregon

force per blade in the supercharger is therefore about 2,000 pounds.

DINOSAUR EGGS

Science Service

DISCOVERY of small fossil eggs of the huge dinosaurs which millions of years ago splashed through the tropical swamps where the bleak bad-lands of the Gobi Desert of Mongolia now lie, is hailed by scientists as important but not surprising. While eagerly awaiting more complete details of the find made by the Third Asiatic Expedition of the American Museum of Natural History, they point out that all reptiles are hatched from eggs and that it has always been held that the prehistoric giant reptiles were no exception to this rule.

It is just by the rarest luck that eggs of fossil creatures are ever found, according to Dr. J. W. Gidley, vertebrate paleontologist of the U. S. National Museum, who explained why no such eggs had ever been found among dinosaur remains in this country. Bones may be preserved by merely becoming buried, but the more fragile egg is not so easily fossilized. It should be remembered that eggs are over ninety per cent. water, and water does not petrify.

Fossil bird eggs have been found, however, he said, and in most such cases the egg shells had been cracked, allowing material to sift into the egg or the egg had formed a cast for the accumulating mineral matter. It is possible, but not probable, that embryos of the prehistoric reptiles may be found in fossilized eggs.

Dr. Leonard Stejneger, biologist and reptile specialist, pointed out that all reptiles are hatched from eggs. Whether this hatching takes place outside the body or inside is merely a matter of time. In the case of the rattlesnake, for instance, the young sometimes leave the egg while still within the mother's body, sometimes they are hatched from the eggs outside the body, and in still other cases both these methods of birth occur.

Commenting on the connection shown by the dinosaurs unearthed in Asia with those of America and the indications of a land bridge between the two continents at some remote time, Dr. Stejneger stated that there are little lizards living to-day in the United States which can not be told from species found in China, and that while there are animals here which are not found in Asia and animals in Asia not found in America, there are abundant numbers of other kinds of animals common to both continents and evidently of a common origin.

EXPLOSION AT THE BUREAU OF STANDARDS

Science Service

WORK of the U. S. Bureau of Standards in the investigating of problems connected with the mechanical and economic efficiency of motor fuels will be only briefly interrupted by the explosion of September 20 that killed or mortally wounded several men and wrecked a large part of the building where the work was being carried on. Only one of the three altitude chambers where engines are tested under conditions approximating great heights was wrecked.

The explosion occurred during the testing of a Ford engine under conditions approximating those experienced in winter. Although conducted in the altitude chamber there had been no reduction of the air pressure, which was that of the surrounding atmosphere, but the temperature in the chamber was reduced to about 10 degrees above zero Fahrenheit. The particular test was an acceleration test, using fuels of four different grades. No one was in the chamber, the instruments being read from outside. With the exception of one man who was crushed under the heavy door which was blown from its hinges, all fatal injuries were due to burns.

The general purpose of the investigations, in which the Society of Automotive Engineers is cooperating, is to conserve the supply of gasoline, to make more use of the lower grades by proper carburetor adjustment and to get a greater number of miles to the gallon and for every dollar expended for fuel. Engineers at the bureau state that it has already been shown that the fuel resources of the country may be increased twenty per cent. by the use of lower grades of gasoline formerly wasted, and that a corresponding increase of mileage may be obtained by more efficient carburetor adjustment, but without any material alteration of carburetor design.

The altitude chamber that was wrecked by the explosion was one of three, the first of which was built during the war to test airplane engines and fuels. Pressure may be reduced to the equivalent of an altitude of 30,000 feet and the temperature lowered to conditions which obtain at that altitude.

The first altitude chamber which was the first of its kind in the world when completed in September, 1917, saved tens of millions of dollars to the American petroleum industry and made unnecessary additional restrictions on privately operated motor cars during the war period. With the data thus obtained on many kinds of fuels the American representatives went into the Inter-Allied Petroleum Conference and showed definitely that American aviation gasoline was superior to that demanded by the French. Since the war the tests made in these chambers have been of great value in the direction of fuel economy and in making possible flights at great altitudes.

LACK OF HURRICANES

Science Service

"YES, we have no hurricanes this year" is the verdict of the U. S. Weather Bureau on one of the most remarkable features of a year noted for the freakishness of its weather. Although the month of September is the season when the dreaded West Indian storms are normally most frequent and severe, not a single one has so far occurred either during the month or throughout the entire summer. Such a record is practically unknown in Weather Bureau annals, and entirely so in the experience of Chief Forecaster E. H. Bowie, who for many years has been responsible for the hurricane warnings sent out.

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Major Bowie, "is apparently the unusual prevalence this summer of high atmospheric pressure over the North Atlantic Ocean, the area of high pressure extending well down into the tropic latitudes. West Indian hurricanes originate from causes not clearly defined but intimately connected with the boundary of the northeast trade winds and the belt of calm along the equator. They occur less frequently when this boundary is near the equator as it seems to be this summer.

"The cause of the extension southwards of the area of high pressure over the North Atlantic is not known. It may be due to unusual coldness of the ocean since cold water chills the air and cold air is heavy air, but this remains to be proved. The fact is that not a single tropical hurricane has been reported this year from any part of the North Atlantic, nor have we felt it necessary even to send out warnings to any part of that great area that the formation of a hurricane was indicated. They have been totally absent.

"In contrast to conditions in the Atlantic, the tropical hurricanes of the Pacific Ocean, or typhoons as they are called there, have been unusually prevalent this summer, especially along the coasts of China and Japan. Apparently the energy which causes the formation of these storms has been shifted from the Atlantic to the Pacific oceans."

THE CITY TOLL OF EARTHQUAKES

News Bulletin, The National Geographic Society

THE earthquake and fire that have destroyed Tokyo and Yokohama in large part seem to constitute the greatest calamity, measured by the reported loss of life, that has ever fallen on any of the great cities of the world. But there is a long string of disasters resulting from earthquakes that have visited great cities in the past that are at least comparable, and that loomed big enough in the minds of the world at the time.

The next greatest calamity of the sort in modern times was the earthquake that in 1908 shook a great slice of Messina, Sicily, into the sea and killed on both the Sicilian and Italian side of the straits more than 75,000 people. In this case fire played no important part in bringing about the destruction, practically all the deaths resulting from falling masonry or from drowning.

The disaster which long stood out as the greatest and most destructive of recent centuries was the tidal wave which swept over the city of Lisbon, capital of Portugal, in 1755. The loss of life in that catastrophe was probably between 50,000 and 60,000.

America's outstanding calamity to a large city resulting from an earthquake was the destruction of San Francisco in 1906. An earthquake severed the water supply lines, and when fire broke out immediately afterwards it soon spread over practically the whole city. Although only about 700 people lost their lives, the property damage amounted to some $200,000,000.

Charleston, S. C., is the only other city of importance in the United States that has suffered from an earthquake. In 1886 a severe quake shook down chimneys and houses in Charleston, but resulted in the loss of only twenty-seven lives.

In the West Indies the most dramatic earthquake incident that has occurred was the slipping of a large part of old Port Royal, Jamaica, into the sea in 1692. This was in the days of the buccaneers, many of whom frequented Port Royal and gave it the name of one of the world's wickedest cities. The superstitious saw in the destruction of the town a modern version of the wiping out of Sodom and Gomorrah.

The chief cities of Central America, excepting those of Honduras and Nicaragua, have repeatedly been destroyed by earthquakes since the advent of the Spaniards in the sixteenth century. The principal sufferer has been Guatemala City, which has been practically destroyed more than half a dozen times, the latest calamity befalling it in 1917. But Guatemala has had no monopoly of disasters. San Salvador, capital of the republic of the same name, and Cartago, capital of Costa Rica, have been shaken into ruins on more than one occasion.

The city which has suffered most greatly in South America is Valparaiso, Chile. Great damage was inflicted by earthquakes in 1730, 1822, 1839, 1873 and most recently in 1906. As early as 1586 earthquakes were bringing destruction to the Pacific coast of South America, Callao being destroyed in that year.

SCIENTIFIC RESEARCH AND NATIONAL DEVELOPMENT

The London Times

AS the war recedes, its lessons are fading out of the minds of men. The late Sir James Dewar, than whom there was no greater authority on chemical research, was never tired of warning those who, he hoped, were influential, that this country was already falling behind its competitors, although during the war it had recovered much of its lost ground. The special example which he selected was the coal-tar industry, now notorious as the chief source of poison-gas in war, but of permanent importance as the source of dyes and drugs.

From the hundreds of distinct substances found in coal-tar, ten so-called "crudes" form the starting-point of most of the processes from which dye-stuffs are manufactured. From the ten "crudes" a number of approximately 300 "intermediates" are produced by a variety of chemical reactions, most of which require the use of large quantities of acids and other chemicals not produced from coal-tars. From the "intermediates" an indefinite number of possible dyestuffs can be prepared, and many thousands of them have actually been produced and marketed. The National Research Council of America has recently tabulated a selection of the industries depending on coal-tar "intermediates" and their derivatives, and has calculated that fifty industries, employing over four million people, depend on coal-tar organic chemistry.

It is worth while giving a few examples of the complexity of the linked processes. The greater bulk of the coal won in Great Britain is either exported, or is burnt

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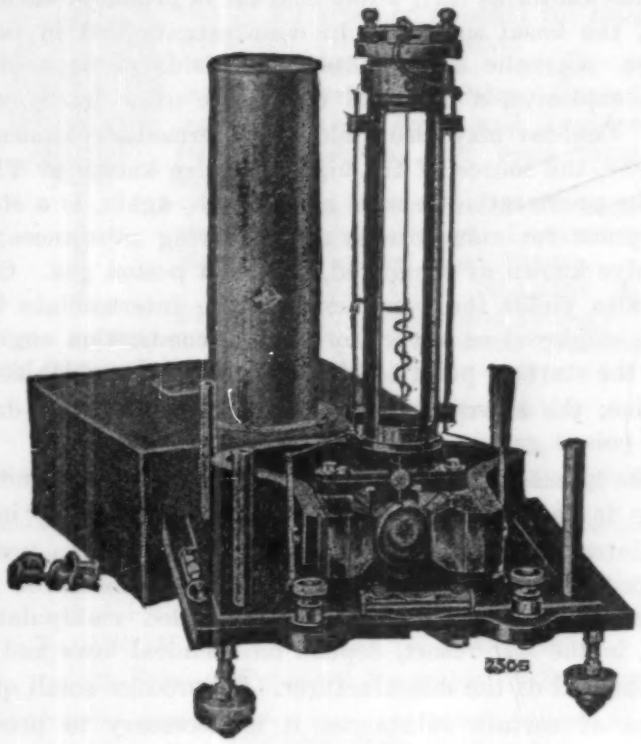

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in the uneconomical, old-fashioned method of open grates and furnaces. If treated by one of the many methods of distillation it yields, on the one hand, coke—a fuel used in a large number of industries, which burns almost without smoke—and, on the other, coal-gas, leaving the residue known as tar. From coal-tar is produced carbolic acid, the basal substance in disinfectants and in many drugs. Carbolic acid, in its turn, yields picric acid—a high explosive, a dye, and the source of a deadly war-gas. Coal-tar may also yield the intermediate known as toluene, the source of the high explosive known as TNT, of the preservative benzoic acid, which, again, is a starting point for many scents and flavoring substances; of the dye known as congo red, and of a poison gas. Coal-tar also yields the even better-known intermediate benzine, employed as a fuel in internal combustion engines, and the starting point of nitro-benzine, from which comes aniline, the starting point for innumerable dyes, drugs and poison gases.

The processes required for extracting the "crudes" from tar and for converting the "crudes" into "intermediates" depend on chemical facts which can not be evaded. The proportion of the various substances produced can be varied slightly by skilled manipulation, but, in the last resort, depend on chemical laws and not on the will of the manufacturer. To produce small quantities of certain substances it is necessary to produce large quantities of others. From the commercial point of view, the large bulks may be the desired substances, the small bulks the "by-products," or, more usually, in accordance with the inconsiderateness of nature, it may be the other way about. Thus anthracene, the most valuable source of modern dyes, is produced from tar in relatively small quantities, whereas the content of the less valuable naphthalene is much larger, and so, unless the valuable substances are to be sold at prices far in excess of their intrinsic value, or, as is frequently the case in the dyes industry, the by-products can be used for military explosives, new uses or markets must be found for these subsidiary substances.

Here is the greatest field for the research chemist, whose work in finding uses and outlets for by-products will often determine the success or failure of the industry. Only a fraction of the task of ascertaining the nature and possible uses of by-products has been accomplished. In a country where the coal-tar industry is conducted on a large scale, the university student with a talent for research can look forward to a real opportunity, and can make for himself a real career. The success of Germany was due less to her possession of chemists of genius than of a large army of competent plodders employed to work out every side avenue that was opened in the course of chemical manufacture. On the one hand, this multitudinous labor, exploring every side issue, by cheapening production, allowed the leaders of the industry to use the extreme methods of commercial warfare against the less well developed industry in other countries; on the other, it led to the constant invention of new applications of coal-tar products in the arts and industries, in medicine and science. And it trained and maintained a body of workers ready, at any moment, to concentrate on any new problem that might arise. Nothing is more certain than that national development in all matters relating to industry, agriculture, public health, and national security depends upon the quantity and quality of research that is carried on. Every modern nation stands in industrial and commercial competition with every other nation; to fall behind in research is to court national disaster.

ITEMS

Science Service

THE old dream of making gold from sea water, or more accurately of extracting from the waters of the oceans the vast amount of gold in solution has been again punctured by German scientists. Some time ago a rumor was circulated that a profitable method of doing this had been invented and that Germany would pay off her reparations by this means. An American scientist even went over there to investigate the story. The rumor was started through the researches of an industrial plant on the shores of the Adriatic which showed that the average amount of gold in sea water was one ounce to 31,000 tons of water. Furthermore, it was shown that the gold is not in simple solution in the water but in what is known as the "colloidal" state, making its isolation much more intricate and costly. The present cost of production from sea water is about 20 times the market price of the precious metal. But here is a goal for inventors. If a way can be found to change the gold in solution from the colloidal to the ionized state characteristic of simple solutions it might be profitably extracted.

THE measuring of the strains of bridges, skyscrapers, airships and structural material in general has been made possible by electricity through use of a device recently perfected by the U. S. Bureau of Standards. It has the great advantage that results may be read or recorded anywhere, although the gauge itself may be in a difficult and inaccessible location. The principle employed by the inventors, B. McCollum and O. S. Peters, is that of the varying electrical resistance of many closely adjacent thin carbon plates when subjected to a compression or pulling strain. The principle has long been known but until Uncle Sam's experts got busy on the problem there had always been insuperable difficulties in the way of practical application of it. The gauge is now in use in a series of tests of impact strains on highway bridges being made at the Iowa State Agricultural College by Professor Almon Fuller, assisted by Mr. Peters, one of the inventors, and with the cooperation of the state highway department. It has also been tested on railway bridges. The device is small in size, being about 10 inches long, less than half as wide, and about an inch and a half thick. The reading apparatus is a specially constructed voltmeter. By connecting wires from the instrument to an oscillograph graphic records of stresses have been made. The invention is not only very sensitive but it recovers itself so quickly after the strain has passed that it may be used in the measurement of vibratory or transient strains with a duration no greater than one thousandth of a second.

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SCIENCE NEWS

HAWAIIAN EXPLORATIONS

Science Service

THE first scientific expedition ever to attempt a complete survey of the life on Uncle Sam's small isolated and uninhabited oceanic islands which extend west from Hawaii for 2,000 miles, has returned here with large collections of biological specimens, including numerous new species of birds, fish and plants. Dr. Alexander Wetmore, of the Biological Survey of the U. S. Department of Agriculture, who had charge of the explorations, stated to-day that this material may throw much new light upon the distribution of life in the Pacific.

The expedition was undertaken by the Biological Survey in cooperation with the Bishop Museum of Honolulu and the United States Navy. The exploring party was transported to and from the islands by the "U. S. S. Tanager," a one thousand ton ship of the mine-sweeper class, and was out for four and a half months, visiting all the islands and stopping at each long enough to make collections, maps and corrections to existing charts.

From Honolulu to Ocean Island, the westernmost of the group, these islands are either of volcanic origin and rocky and frequently dangerous to approach, or low atolls surrounded by coral reefs.

The mysterious Necker Island, about one mile long, uninhabited and barren, was visited. Here the party saw strange stone platforms, thought to have been built in prehistoric times by Polynesian peoples and used as a religious shrine to which pilgrimages were made from distant islands. The explorers found peculiar idols and implements used by the ancient people on such occasions. Evidently Necker Island was never permanently inhabited, but Nihoa, the nearest island from which the worshipers could have come, is 150 miles away and the main Hawaiian group is about 300 miles distant. No mention of this island has been found in Hawaiian myths or legends.

While practically all the islands visited were uninhabited, they were found to be exceedingly rich in birds. They form what is known as the Hawaiian Bird Reservation. Sandpipers, curlews and golden plover, birds which breed in Alaska and the Arctic regions, were seen in numbers and much knowledge was gained in regard to the habits of these remarkable long-distance migrants.

Donald R. Dickey, motion-picture expert with the expedition, secured many reels which reveal the strange habits of some of the oceanic birds. On Laysan Island he secured pictures of the "dance" of the albatross. These seabirds, as large as geese, engage in this dance in pairs and the dance is continued during the entire eight months the albatrosses are on land. It consists in a regular series of steps and motions in which they advance and retreat, fence with their bills, raise one wing, and similar motions which Dr. Wetmore referred to as the Laysan fox trot.

The birds found on these islands were as tame as domestic chickens. When one of the scientists would sit down to make a few notes, the albatrosses would walk up to him and after apparently satisfying their curiosity, turn and discuss him among themselves.

Johnston Island, the southernmost of the islands of the Territory of Hawaii, and Wake Island, 2,000 miles west, were also visited. Many rare fishes were found and at Johnston Island several unmapped reefs were charted by navy airmen from an airplane carried by the expedition for that purpose. So small and isolated is this last mentioned bit of American territory that Japanese fishermen from Hawaii, who make trips into these waters every year, frequently return to report that they can not find it.

This was the first scientific expedition of the kind in which the navy has taken part since the Wilkes Expedition of 1842.

HORSE CAN EXERT 21 H. P. NEW TEST SHOWS

Science Service

THAT a horse may develop as much as 21 horsepower in an emergency has been demonstrated in a series of experiments conducted by the Horse Association of America with a testing apparatus invented by E. V. Collins, of the engineering department of the Iowa State College of Agriculture and Mechanic Arts, for the purpose of finding out just how much a horse or a mule can pull.

The tests showed a team of good horses can exert a tractive pull of 2,000 pounds, or enough to lift a ton vertically. Such pulls as these are not needed on ordinary roads. It was shown that on a concrete road surface the amount of pull required to start a farm wagon, weighing with its load more than 7,700 pounds, was only 125 pounds.

The influence of the road surface was demonstrated by additional experiments which showed that to start the same load on a good brick road required a pull of 200 pounds, while 300 pounds were required on an asphalt surface and 520 pounds on a good dirt and cinder surface. In other words, the same team can pull four times as much on a concrete road as it can on the best surfaced dirt road.

The new tests emphasized the value of breeding and of training in horses and have opened up new possibilities in the direction of scientific measurement of performance of differing breeds and individuals. While the value of weight in draught animals was again demonstrated, a surprising result of the tests was that gameness counted almost as much. A little broncho team, weighing 455 pounds less than its competitors, pulled larger loads in proportion to weight than any other team entered in the tests in any class. More extended tests will be made next year.

The apparatus consists essentially of suspended

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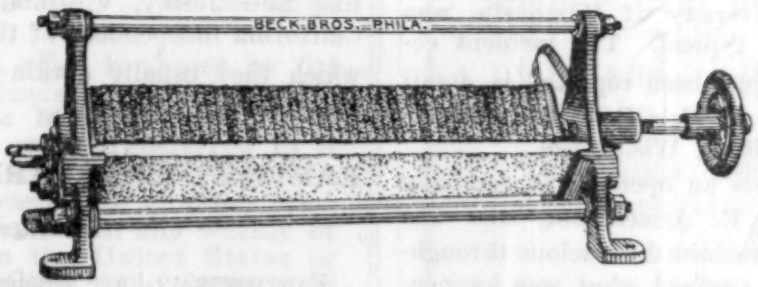

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DEATHS DUE TO AUTOMOBILES

Science Service

DEATHS from automobile accidents continue to increase while the general death rate among industrial policyholders of the Metropolitan Life Insurance Company declined to nearly the lowest August figure ever recorded, according to the summary for that month just compiled by Dr. Louis I. Dublin, statistician.

Deaths among the insured due to automobiles were at the rate of 18.4 per 100,000 as compared with a figure of 15.4 for the same month last year. Fatal accidents of all classes also showed an increase, the death rate from this general cause amounting to 73.8 per 100,000 as compared with 67.2 in August, 1922.

The death rate as a whole among the insured was the lowest for any month of the year and the lowest August death rate ever recorded among this group of insured, except for the figure for August, 1919. The rate this year was 7.7 per 1,000 as against 7.6 in the former year.

If these figures are representative of the general population a person now is in much more danger of being killed by an accident than of dying from either cerebral hemorrhage or Bright's disease. The mortality rates of these two important causes of death sank last month to 47.5 and 58.3 per 100,000 policyholders, respectively, the lowest figure ever recorded for these diseases in any month among this important group of the population.

LIGHTNING STROKE

Science Service

DEATH from a lightning stroke may not be as painless as has been supposed, if the experience of M. L. McQueen, instructor at the University of Wisconsin, who was struck and recovered, is typical. The incident occurred this summer and has just been reported in detail to the U. S. Weather Bureau by Eric R. Miller, meteorologist in charge of the Madison, Wis., office.

McQueen was walking across an open lot in company with another instructor, W. E. Armentrout, who was killed by the bolt. McQueen remained conscious throughout his experience and fully realized what was happening to him. Relating it some days afterwards he said the pain from the spasmodic contractions of his muscles was terrible, but was nearly equalled by that due to the terrific heat of the flash and the noise. He also suffered from a sensation of intense pressure in the head.

The current entered his body at the left shoulder, which was seared over an area of four square inches. His leg muscles near the ankles were sprained and wrenched by spasmodic contractions. He was paralyzed from the waist down for several hours and was weeks recovering from the burns and the injury to his muscles.

That iron has little directive effect on lightning is indicated by the fact that a railroad rail lay only 10 feet away from the two men, railway construction work within 30 feet, while within less than 50 yards were a tall crane, wire fences and buildings. An iron smokestack was not much further away in the direction from which the cloud had come.

SEED POTATOES

Science Service

How to make two crops of white potatoes grow where only one grew before has been simplified by a discovery of Professor Joseph T. Rosa, of the University of California. The difficulty in sections where two crops are possible has been that the seed potatoes from the first crop must be seasoned three or four months before planting if they are to sprout readily.

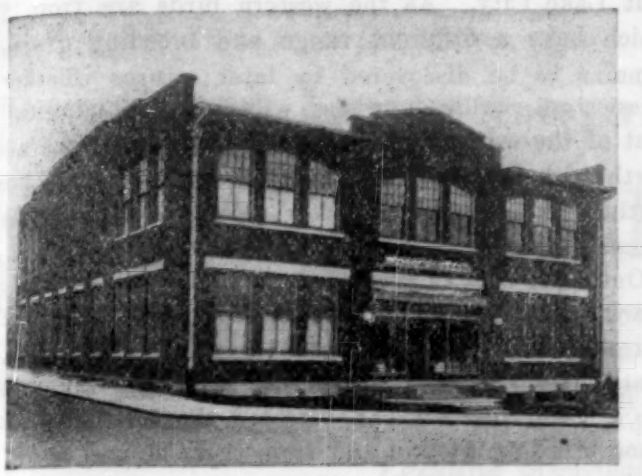
Professor Rosa has found that if the new seed potatoes are cut up in the usual way for planting and then dipped into a weak solution of nitrate of soda for from thirty minutes to an hour a short time before they are put into the ground they will sprout as quickly as seasoned seed. The common fertilizer grade of nitrate of soda can be used at the rate of three and a half pounds to ten gallons of water, and as the solution may be used repeatedly the cost is very small. In an experiment started February 23, 1923, seed potatoes treated by this method came up quickly and gave practically a 100 per cent. stand by April 3, while untreated seed came up much more slowly and did not show a full stand until April 21, nearly three weeks later. It was found that the treatment was useless unless the tubers were cut before dipping in the solution. Besides enabling the potato grower to use his early crop potatoes to plant a fall crop and thus get two crops in one year on the same land, Professor Rosa believes that the new treatment will enable growers to mature their early crop still earlier than at present, and thus get the benefit of the higher prices that usually prevail for early potatoes. It may be entirely possible, he says, to make important potato states like New Jersey, Virginia, the Carolinas, Florida and California independent of the more northern states, from which they usually obtain most of their seed potatoes for planting.

EARTHWORMS LEARNING BY EXPERIENCE

Science Service

EARTHWORMS have memory and may be trained in the way they should go, but their brains are not in their heads but in their abdomens. Professor L. Heck, of the University of Prague, has announced this discovery as the result of experiments with a collection of worms some five hundred in number. They were introduced into a passage shaped like a capital T and carved from a block of wood which was covered with a glass plate so that the movements of the little creatures might be observed. When they came to the junction about half of them turned one way and half the other.

Then it was arranged so that those that took the left-hand passage received a mild but presumably disagreeable electric shock. At first the worms did not know just



THE SCIENCE PRESS PRINTING COMPANY

The Science Press Printing Company has been incorporated by the State of Pennsylvania for the printing of scientific and educational journals, monographs and books. The object of the directors is to establish on a permanent basis a press especially equipped for printing scientific literature in the best way, with compositors, pressmen and proof-readers trained for technical work. It is a business corporation; but it has been founded to provide facilities essential for the advancement of science. J. McKeen Cattell is president; A. E. Urban is general manager.

The corporation owns its building at Lancaster, Pennsylvania, over 14,000 square feet of floor space lighted on all sides, with space for printing a hundred scientific journals. It has the best obtainable presses, composing machinery and binding equipment and these will be increased as needed. What is more important, it has the most competent pressmen and compositors in a city which since "Science" was first printed there in 1894 has become a center for fine scientific printing. The costs are only about three fourths as much as in the large cities.

The capacity of the office is shown by the circumstance that "Science," "School and Society," "The Scientific Monthly" and "The American Naturalist" were transferred to it on July 1 without the least delay or difficulty. The typography and presswork of these journals will bear comparison with any weekly or monthly publication in the United States or elsewhere. Those authors who have read proofs will know the correctness of the composition. A distinguished scientific man writes to the editor of "Science": "I corrected my first proof a year before you were born and the one I returned yesterday was the first one in my long experience that needed no correction."

Only a limited number of publications can be accepted at present as the business of the office will not be enlarged beyond its ability to do the best work with promptness. All correspondence should be addressed to the general manager, A. E. Urban, The Science Press Printing Company, Lancaster, Pa.

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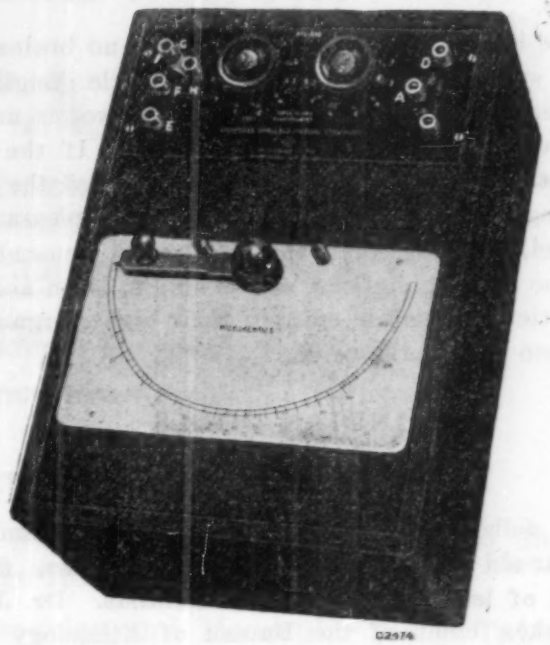

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what to make of all this, but after they had all been through the experience about two hundred times, they nearly all were converted to "safety first" and took the right hand turn. When the electrodes were then moved to the right-hand passage they learned to shift to the other after only 65 passages, evidently showing more aptitude.

In the human sense, earthworms have no brains; their nervous systems consist of a series of little ganglions, or nerve centers, on the under side of the worms and connected with each other by nerve fibers. If the worms were cut in two, the fragments still showed the ability to distinguish between the safe and the unpleasant road to travel, showing that the earthworm remembers in every one of his ganglions, and is able to learn and profit by experience, which in spite of their higher organization many men are unable to do.

INDIAN DOLLS

Science Service

CLAY dolls patted into shape by the baby hands of a four-year-old Navajo papoose may overturn finespun theories of learned ethnological scientists. Dr. J. Walter Fewkes, chief of the Bureau of Ethnology of the Smithsonian Institution, has received a collection of small toy people made by an Indian child in northern Arizona which are remarkably similar to images found in excavations on prehistoric American city sites and thought to be fetishes or magic charms worn by savage warriors as a protection against injury.

Dr. Fewkes laughingly admitted that it is possible that the joke is on the ethnologists. He said that in the course of his numerous excavations on ancient Indian sites he had probably found many such images and interpreted them as fetishes. The images unearthed may have been so used and the childish working of the adult savage mind may be responsible for their similarity with the precocious product of the modern Navajo child.

The figures just received are about two inches long and the majority of them apparently represent women. The little artist failed to furnish them with any eyes, ears or noses.

MIGRATION OF MALLARD DUCKS

Science Service

INTERESTING facts in regard to the migration of mallard ducks were told by Frederick C. Lincoln, of the U. S. Biological Survey, in an address before the American Ornithologists' Union in convention at Cambridge, Mass., on October 10. By means of pictures and maps Mr. Lincoln showed the methods used and the results obtained in banding 4,000 mallard ducks for identification.

The center of the great breeding range of the mallard duck is in lower Saskatchewan, Canada, while the center of its winter range is along the lower Mississippi from the mouth of the Ohio to the Gulf. Among the birds marked by Mr. Lincoln in Illinois were some which later turned up in Texas, a few miles west of Houston. The route apparently taken by these birds converged at that point with the routes taken by ducks formerly banded at Salt Lake City. As the western birds are from flocks which have a different range and breeding ground, it remains to be discovered by later returns whether the Mississippi mallards, whose winter range mingles with that of the western birds, join the western flocks and fly north with them in the spring or whether their homing instinct is unerring and they return to Canada by the Mississippi valley route.

One duck caught at the mouth of the Mississippi some years ago was shipped to New York, banded there and released, and was killed in Saskatchewan, Canada, two years later. Apparently in this case, said Mr. Lincoln, the homing instinct had directed the bird back to his home breeding ground and from there he had twice been back and forth on the old Mississippi route before he was shot.

Some of the ducks banded in Illinois have been found in the South Atlantic states, and whether they flew across the mountains or took a more circuitous route is yet to be determined by additional returns from the banding experiments.

NATIONAL VALUE OF RESEARCH

London Times

COAL-TAR chemistry is only an apposite instance of the value of research and the national danger of neglecting it. It is a dramatic instance, partly because the basal discovery which led to German domination in dyes, drugs and explosives was made in England, and partly because whilst England is trying to provide for her future by big ships, new harbors and air squadrons, Germany is concentrating on chemical industry and chemical research.

But the principle is more important than the instance. By all means let us hope that coal-tar chemistry in all its ramifications of dyes, drugs and munitions will be firmly established in this country, and that we shall no longer run the risk of having our industries arrested and our national will to survive thwarted because another country is suddenly able to cut off our supplies. Science, however, does not stand still, and even the firm establishment (unhappily not yet accomplished) of the dye industry in this country may still leave us in danger.

It is certainly not easy to predict which of the many lines of contemporary discovery in pure science is going to provide the "key" to national security in the next quarter of a century. But two possibilities may be suggested merely as indications of what may happen.

Most of the energy used in human operations comes from fuel stored in past ages, for water-power, tidal-power, wind-power, and other accessory supplies are relatively insignificant and more difficult to harness. Wood, peat and the products of existing vegetation are still also of relatively small significance, although the use of power alcohol may come to have a substantial place. The total world supply of power, in actual fact, is drawn chiefly from coal, oil and shale, substances which are limited in their total amount, irregular in their geograph-

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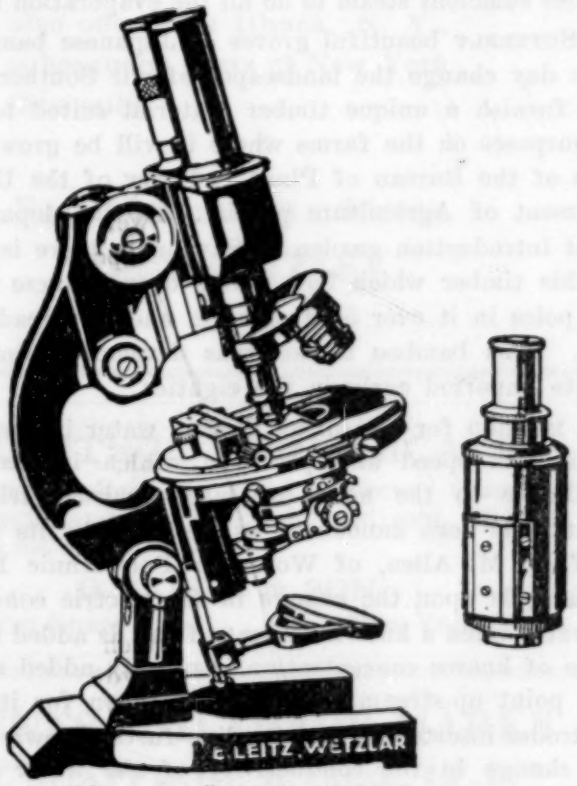

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ical distribution, and require labor to win them and transport to carry them where they are required. The rising cost to the consumer of all kinds of fuel shows that the world supply is not expanding to meet the demands on it.

Science may meet the demand for fuel in two ways. It may contrive such economies in utilizing it as to expand its value greatly, a process more likely to be carried out in countries where the local supplies are limited than in a country like Great Britain, which still exports the bulk of its coal raw. The economical utilization of fuel may become one of the conditions of survival. But a new source of energy may be discovered, and physicists are not without hope that the vast reservoir of energy locked up in the constitution of matter—what is known as sub-atomic energy—may yet be released for human purposes. The industrial applications of such a discovery, if possessed by a single nation, would give command of the world.

We spend enormous sums on the defense of the realm and can apparently afford many millions to prepare now for contingencies that may never arise in the remotest parts of the world. We have a committee of imperial defense, whose sole business is to keep constant watch on future dangers and to concert measures for meeting them. A civilian finds difficulty in forming a judgment on the decisions of naval, military and air-force experts, and the country as a whole is ready to provide what money the experts demand to secure the safety of the peoples of the empire. But there is no public department, no committee, no organization charged with the duty of watching the developments of scientific research here and in other countries in the interests of national safety. And yet we may be in greater danger from the strategy of applied science than from all that armies and navies and aeroplanes can accomplish against us. We, like every other nation, are engaged in a constant warfare against the forces of nature, a warfare in which no mistakes are excused and no quarter is given. We, like every other nation, are in constant peaceful struggle with other nations for our industries and our commerce. We, like every other nation, might at any time find our most costly armaments and implements of war out of date in the presence of some new application of scientific discovery.

Fortunately there is an increasing activity in research and a slowly growing feeling in its favor amongst all classes of the population. But the development of science also means the development of its applications, and those who are most zealous about the one may be—usually are—indifferent about the other. The services of scientific men, even of the highest distinction, are cheap, and it would cost little to support a small committee of scientific defense, whose sole duty would be to watch the developments of science throughout the world and to advise government departments as to possible applications of new discoveries.

ITEMS

Science Service

THE wood pulp resources of the world may be greatly increased by the use of a new process of manufacture described by Professor Ralph H. McKee, of Columbia University, before the American Chemical Society. There are several species of coniferous woods which are at present unsuited for manufacture into sulphite pulp because of their high content of resinous matter. The process which he described consists in dissolving out the turpentine and rosin with liquid sulphur dioxide and then converting the residue into the usual sulphite pulp which is stated to be of good quality. It was also stated that turpentine and rosin could be produced commercially by this process cheaper than by present methods. Dr. McKee also described a new process for eliminating the nuisance of waste sulphite liquors from pulp mills. This process, which he said has been successful and profitable on a commercial scale, depends upon the fermentation of the liquor. Commercial alcohol is obtained and the residue evaporated and used as fuel. Dr. McKee stated that the fuel so obtained from the average pulp mill is adequate to give a thousand horsepower day and night, besides sufficient steam to do all the evaporation required.

"SUPERBLY beautiful groves of Japanese bamboo will some day change the landscapes of our Southern States and furnish a unique timber material suited to a host of purposes on the farms where it will be grown," officials of the Bureau of Plant Industry of the U. S. Department of Agriculture predict. At the department's plant introduction garden in Savannah, there is a grove of this timber which now covers over an acre of land, has poles in it over 55 feet high, and is spreading rapidly. This bamboo thicket was developed from a few plants imported early in the eighties.

A METHOD for measuring flowing water in large quantities with speed and precision, which is particularly applicable to the needs of large hydroelectric power plants, has been announced as a success by its inventor, Prof. C. M. Allen, of Worcester Polytechnic Institute. It depends upon the change in the electric conductivity of water when a known amount of salt is added to it. A brine of known concentration is quickly added at a certain point up-stream and the time taken for it to pass electrodes inserted in the pipe line further down is noted, the change in the conductivity of the water marking accurately the time of the passage of the brine. If, then, the volume of the conduit between the two points is known, the volume of flow may be accurately determined. Comparison of this method with slower and more cumbersome methods now in use have demonstrated its accuracy.

SUBMARINES with eyes in the clouds and nerves of radio threaten to make life more dangerous for warships plowing the surface of the sea. Reports of torpedo practice received by the Navy Department from the commander of the Pacific Battle Fleet show that the combined use of submarines, airplanes and wireless has increased the efficiency of submarine attack. In order to aid and expedite the attack of a submarine division on a target ship in operations in progress on the west coast, DH-4B spotting planes transmitted an accurate estimate of the course and speed of the target ship to the submarines by wireless. Considerable improvement in the scores of the under-water craft was reported.

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SCIENCE NEWS

EARTHQUAKES AND ENGINEERING CONSTRUCTION

Science Service

AN investigation of the Japanese earthquake with special reference to its effect upon buildings and engineering construction of all sorts is about to be undertaken by the American Society of Civil Engineers. Data bearing on the subject will be collected and compared with similar data collected after similar disasters in the past, with the view to putting them all on record permanently so that they may be accessible to every one concerned in the design and erection of structures of all kinds.

Colonel John Millis, U. S. Army, Corps of Engineers, retired, a member of the special earthquake committee, has explained to Science Service: "It has been demonstrated in a most disastrous way that with all the investigation that has been given to the subject of earthquakes, man has not been able to devise constructions for housing and other indispensable human requirements of the civilized world which will withstand these disturbances. It is beyond human power to avert earthquakes and very little progress has so far been made in the matter of prediction of their occurrence. Even if this could be done with measurable success there remains the problem of designing and building structures in such a way as to withstand as far as possible an experience which is practically certain to occur in many localities and which may break out in the most unexpected places."

"This latter was illustrated," Colonel Millis said, "by the Charleston earthquake, and by the severe shocks which occurred over the middle Mississippi valley more than 100 years ago. This earthquake would inevitably have caused great destruction had there been structures in the locality susceptible to destruction by such disturbances of the earth's crust."

Colonel Millis, of Cleveland, Ohio, is the eastern member of the special earthquake committee and other members, including the chairman, will be selected from Pacific Coast members of the American Society of Civil Engineers. Persons who may be able to contribute information bearing upon this subject, which is literally of world-wide interest, are urged to communicate all available data to John H. Dunlap, secretary, American Society of Civil Engineers, 33 West 39th St., New York, N. Y.

RADIO BEACONS

Science Service

RADIO beacons, used in connection with direction finders on ships for the purpose of ascertaining position at sea in thick weather, are given the highest praise by Commodore Sir Bertram Hayes and other navigating officers of the White Star liner *Majestic*, one of the largest vessels afloat, according to a report of the U. S. Lighthouse Service. Radio beacons are operated on an entirely different principle from radio compass stations such as the one at Pt. Arguello, California, which has recently figured prominently in the inquiry concerning the wreck of seven U. S. destroyers near that point. In the radio compass station, the position of the ship is worked out on shore; in the radio beacon system, by the operator on shipboard.

Officers of the *Majestic* report that on a recent voyage from New York to Boston and return, the vessel was in fog nearly the whole time and was navigated almost wholly by radio bearings taken from the ship. Nantucket lightship was made so closely that the *Majestic* passed between it and the marking buoy.

On a recent voyage to Europe the big liner, which was in fog four days before reaching Cherbourg, was navigated by radio bearings on approaching the French coast, and made the entrance to Cherbourg harbor exactly. The radio direction finder is also used on the *Majestic* for locating other vessels in fog. The direction-finding work on the ship is given preference over all other radio work.

Direction finders for use in connection with radio beacons are being installed on a number of vessels of the Cunard line which has not heretofore used this instrument. A new radio beacon station is being installed at Cape Ray on the Newfoundland coast.

THE AMERICAN CHESTNUT CROP

Science Service

EFFORTS to save the chestnut industry of this country, which is rapidly being swept out of existence by the chestnut blight, were described to the Northern Nut Growers Association in fourteenth annual convention at Washington by C. A. Reed, of the U. S. Department of Agriculture. He told of failures, disappointments and promising successes in securing trees resistant to this damaging plant disease.

The chestnut blight is the result of a fungus growth which gets under the bark of chestnut trees and destroys the trees by girdling them. It was discovered in 1904 in trees on Long Island which had been brought in from Asia. Since that time, it has spread throughout the chestnut growing regions of the eastern United States, made gaunt white skeletons of what were once valuable food and timber trees, and threatens to completely wipe out the American sweet chestnut.

Among the once-promising experiments which have proved a disappointment, according to Mr. Reed, is the cross of the native small sweet chinkapin with the large Japanese chestnut which is almost without flavor. Seedlings from this cross developed nuts in eighteen months and during their early days appeared to be resistant to the blight. Later the blight also attacked them.

The most promising variety now appears to be the Chinese chestnut. The chestnut blight originated in China and the trees which have survived there are those not subject to it. Although the American sweet chestnut is the best chestnut known, the Chinese chestnut is also of good size and quality, and experiments indicate that it

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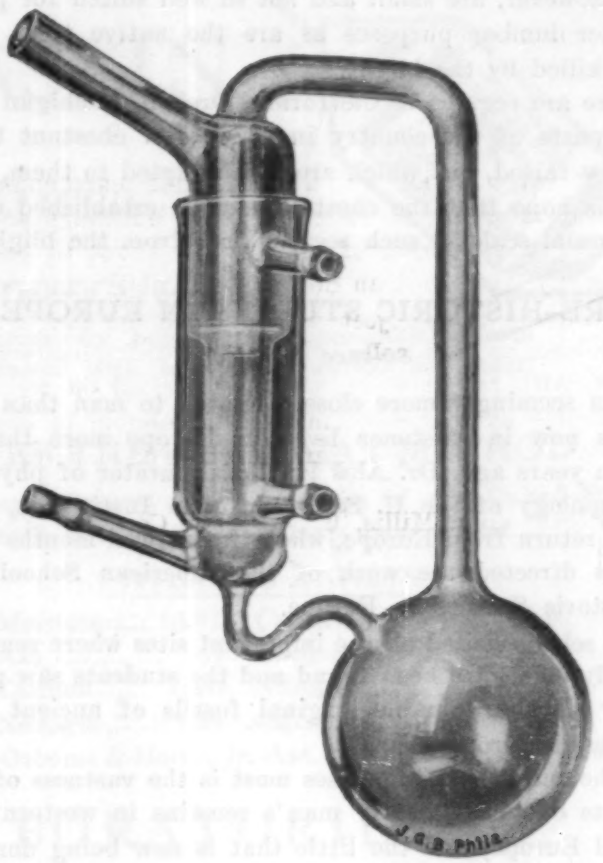

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PRE-HISTORIC STUDIES IN EUROPE

Science Service

APES seemingly more closely related to man than any species now in existence lived in Europe more than a million years ago, Dr. Aleš Hrdlička, curator of physical anthropology of the U. S. Smithsonian Institution, said on his return from Europe, where for several months past he has directed the work of the American School for Prehistoric Studies in Europe.

The school visited all the important sites where remains of early man have been found and the students saw practically all the valuable original fossils of ancient men and fossil European apes.

"The thing that impresses most is the vastness of the deposits containing early man's remains in western and central Europe, and the little that is now being done in many places in the way of systematic investigation of them.

"European countries are in general too impoverished to carry on the work and what interest is being shown is mostly by individuals and directed to the cultural rather than the natural history of man.

"The large fossil apes which lived in Europe from one to three million years ago are even less known than ancient man, yet the study of these forms is of great importance. Observation and careful measurements have shown in at least one case, that of the *Dryopithecus rhenanus*, that these fossil apes were more closely related to human beings than most if not all of the other known species of apes. Further search for the remains of these forms is of the greatest importance, for they may connect with some of man's precursors, if not with his own ancestry."

Dr. Hrdlička stated that these fields of investigation present a great opportunity to American scientists. Sites which are known to contain remains of early man are readily available for exploration and American participation in the work would prove a leaven which would stimulate and rejuvenate work everywhere, besides being sure of results of great value to science and to human knowledge in general.

"As to the previous specimens that have already been discovered and which may be counted already by the scores, it is absolutely essential that they be studied in the original." Observations on imperfect casts have already led to serious errors. In some cases scientists working with casts have arrived at wrong conclusions because essential features of the skull or the jaw were either perverted or not brought out in the cast. In one instance, Dr. Hrdlička said, not only he, but even the representative of the institution in which both the originals and the casts were present, had trouble in matching the casts and pictures with the originals because they were so unlike. Measurements of the teeth and other fossil remains in particular, he said, require such accuracy that a mistake of a very small fraction of an inch may mean throwing the specimen out of its own into another class.

Among the periods of the Ice Ages, about which least is known of the development of man, Dr. Hrdlička mentioned the second interglacial period when for thousands of years the glaciers melted, warm climate prevailed in Europe, and lions, camels, ancient elephants, rhinoceroses and other tropical creatures roamed over that part of the world. Worked pointed stones used as weapons and implements by the early men of this period are plentiful, but fossil bones of man, except for one jaw-bone found in Heidelberg, Germany, have not as yet been unearthed. Yet they are there somewhere, as are even earlier traces of man, and are waiting to be unearthed by systematic work on a larger scale than is now practiced in Europe.

BEAVERS AND FOREST FIRES

London Times

THE Roosevelt Wild Life Forest Experiment Station of the New York State College of Forestry, Syracuse University, has issued a report on the beaver in the northern section of Hamilton and Herkimer counties in the Adirondacks. The report is based on an investigation by Dr. Charles E. Johnson, fur naturalist connected with the Roosevelt Station.

Dr. Johnson makes some interesting statements regarding the relationship of beaver operations and forest fires. Two opposite opinions on this subject are dealt with in the report. It is said by some that the dead timber in beaver flows constitutes a potential fire menace. That as the beaver dams in time will be abandoned and gradually disintegrate the receding water will leave exposed masses of dry timber, in which forest fires might originate and travel rapidly. Dr. Johnson shows, however, that where beaver are present in large numbers that new families reoccupy dams about as fast as they are abandoned and that the period of fire risk would be relatively short.

On the other hand, it is pointed out that beaver flows constitute effective fire breaks. Streams a few inches or a few feet wide are frequently transformed by the beaver into a series of ponds or flows, rods in width and hundreds of yards in length, and in heavily forested parts or in open cut-over or burned areas the barrier formed by such flows may prove of considerable value in a fire protection system. Flows are considered a disadvantage by some when it comes to fighting fires, as they are thought to make it impossible to maintain good passable trails, therefore rendering communication difficult and thus outweighing any advantage they might have in forming a barrier to the progress of forest fires.

Dr. Johnson's report contains much information on the habits and numbers of beavers, their operations and effect upon forest conditions of the Adirondacks. The bulletin will be mailed free to any applicant.

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PRESERVATIVES IN FOOD

London Times

A DEPARTMENTAL committee of the Ministry of Health is at present inquiring into the use of preservatives and coloring matters in food and is to report whether the use of such materials or any of them is injurious to health and, if so, in what quantities their use becomes injurious. Many physiologists have come to look on food preservatives with suspicion. Nothing, it is admitted, has been proved, but there is a feeling that the something wrong may well be connected with the change in the character of the food supplies of the country. The question has many difficulties. America has tried to deal with the situation by legislation and regulations establishing standards of composition for innumerable articles, but these, it is contended, have not solved the problem.

Public authorities in this country have not as a general rule concerned themselves greatly where the character or percentage of a preservative in food is unlikely to prove immediately dangerous, but the reports of medical officers are strewn with revelations of food poisons. Sir George Newman, in his report for 1922 as Chief Medical Officer of the Ministry of Health, states that during the year a considerable number of samples were examined in the ministry's chemical laboratory. Among them were liquid eggs and sponge cakes for boric acid, imported caviare preserved with formaldehyde, indelible ink for marking carcasses, cereal products, cocoa, tea and baking powders examined for arsenic, cheese—from a food-poisoning outbreak at Dover—examined for metallic poisons and stewed apples contaminated with zinc from cooking vessels. A large amount of work, Sir George Newman states, has been done in perfecting the electrolytic method of estimating arsenic. An apparatus has been evolved which constitutes a great improvement on previous types, and is likely to be adopted in other laboratories.

The presence of arsenic in food materials can in most cases be traced to the use of ingredients in the preparation of which arsenical sulphuric acid has been used or which have been dried in contact with the fumes from arsenical fuel. The report records among other cases of food poisoning an outbreak in July, last year, due to lead in beer caused by conveyance in tank wagons to public houses where it was placed in lead-glazed tanks. In Manchester samples from soda fountains revealed the presence of lead, copper and zinc in dangerous quantities due to the erosion of tin in a tin-lined copper cylinder. Sir George Newman adds that "under modern conditions the feeding of the people of these islands, a large proportion of whom are town-dwellers, with foodstuffs derived in greater or less degree from abroad is a complex problem. Of necessity, canned and prepared foods now enter largely into the dietary of the British public and form an important and valuable part of the food supply of the nation. That illness of one sort or another should occasionally result from their use, as it does from other forms of food, is well-nigh inevitable. Having regard, however, to the enormous quantities of canned and prepared foods consumed, the remarkable fact is not that accidents should occasionally occur from their use, but that these accidents should have been so few and far between."

ITEMS

Science Service

THRESHING machines, in addition to the seed and wind, are important in spreading the spores of flag smut through wheat fields in several counties of Illinois and Missouri, in the opinion of R. D. Rands, who has investigated the disease for the U. S. Department of Agriculture. "That thrashing machines are a common carrier of this smut from farm to farm, just as it is known to distribute bunt spores, wild onions, cockle and volunteer rye, is probable if we may judge from our success in locating advance infections by following threshing runs. For example, we have frequently found flag smut on farms surrounded by apparently disease-free ones, located long distances from the nearest known infection where the farmer had for many years used his own wheat for seed, but usually where an infected crop had been threshed before his in another part of the same run. While it is of course possible that the smut was carried to such farms by wind or other agents, it seems more likely that the threshing machine or bundle wagon was responsible."

AFTER smoking a cigar or three cigarettes, blood pressure rises and the heart beats faster. This is the finding of Dr. Robert L. Bates, psychologist at Johns Hopkins University, who carried on experiments so that physicians could have real evidence on the dangers of smoking during sickness. The rise in blood pressure and heart rate is only as much as might occur normally due to other conditions and both return to normal in from twenty to thirty minutes. Dr. Bates was unable to determine how much of the change was due to the products of smoking tobacco and how much to mental effects, for it is known that emotions and mental processes may also affect pressure and heart rate.

CITY planners should cooperate with the Weather Bureau and learn how to let the wind blow the smoke out into the country rather than over the residence districts, says C. J. Root, meteorologist of the local office of the Weather Bureau, who has acted as adviser to the commission in Springfield, Ill., which is making a comprehensive city plan for future development. An examination of records there showed the prevailing wind to be from the south in all months except January and February, and the industrial district is accordingly to be localized in the northeast section of the city. Where natural features such as lakes and rivers prevent the growth of a city in a given direction or the establishment of an industrial zone to leeward of the business and residential, some modification is necessary, Mr. Root says, although in all cases an intelligent use of Weather Bureau records may save millions of dollars damage from smoke and soot.

AN important railroad in the Belgian Congo in Central Africa is soon to be electrified and power formerly wasted from rapids and waterfalls will be made to replace expensive coal brought from Europe.

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SCIENCE NEWS

PERIODICITY OF INFLUENZA

Science Service

FURTHER evidence of periodicity in outbreaks of influenza is afforded by a recent increase in the number of cases of the disease in London and other English cities, according to Dr. George W. McCoy, director of the U. S. Hygienic Laboratory. But the recurrence of the disease in England does not necessarily mean an epidemic.

The reports from overseas stated that the first increase in the number of cases of influenza in English cities was noted during the third week in September. This was nearly 33 weeks from the date of the last outbreak there, a period which is coming to be associated with revivals of the disease. This period was first observed by Dr. Brownlee, statistician of the British Medical Research Council, and it has been recently confirmed by the health authorities of Liverpool.

Commenting on these reports, Dr. McCoy said: "There is much evidence for a recurrent periodicity in influenza epidemics for a period of some years following a general world epidemic such as was experienced in 1918–19. This period seems to be close to eight months or 33 weeks from the beginning of one epidemic to that of another, although irregularities sometimes occur. This is particularly true if a recurrence is due during the warm months. In such a case only a few cases are usually noted and no real epidemic develops. For example, the 33 weeks period since the outbreak of the last epidemic here ended late in August, but there has been no outbreak. The next date for recurrence if the period holds good is late next spring, but the lateness of the season will probably prevent much of an outbreak."

Dr. McCoy called attention to a periodicity in epidemics of other infectious diseases such as measles and scarlet fever.

"It has been found in New York," he said, "that measles is much more prevalent on alternate years, while for scarlet fever the period seems to be four or five years. Why this is so we do not know."

Some medical authorities in England have hazarded a guess that influenza recurs periodically and spontaneously in some individuals who have suffered from the disease and have cited the outbreak of the disease on ships which have been long at set as favoring such a theory, but it has as yet not found general acceptance.

LABORATORY WORKERS AND INFECTIOUS DISEASE

Science Service

TWO cases of Malta fever, a highly infectious but seldom fatal disease and one very rare in this country, have occurred among the laboratory staff of the U. S. Public Health Service Hygienic Laboratory, where the disease is under investigation. Both patients are now convalescent.

Goats are subject to the disease, and a few months ago there was an outbreak of it in Arizona in sections where unpasteurized goat's milk was extensively used as food. Doctors and workers from the Hygienic Laboratory were sent to the spot and after quelling the outbreak returned to Washington where further inquiry as to methods for the prevention and cure of the malady were undertaken. The two cases among the laboratory workers followed.

Malta fever, as its name indicates, was formerly very prevalent on the island of that name and to a less extent throughout the whole Mediterranean basin where goats' milk is a staple food. While rarely fatal, it causes disability for long periods in many cases, convalescence being interrupted and tedious.

The two cases of this disease among workers in the Hygienic Laboratory calls renewed attention to the risks run by the doctors and scientists there who handle deadly germs with the same indifference to danger that is shown by workers with high explosives. Not long ago there were six cases in the laboratory of a rare disease known as tularemia. Rabbits and other small mammals have been found to be infected with this disease which is easily transmitted to human beings, causing a long continued fever and prolonged disability, although the death rate is practically zero. So infectious is this disease that practically every laboratory worker who deals with it catches it sooner or later.

In a more serious class is the deadly Rocky Mountain spotted fever, a disease which because of its prevalence in parts of the northern Rocky Mountain region has caused the abandonment of settlements and ranches and serious loss of life and property. Cattle are subject to it and it is usually transmitted to man through the bite of a certain species of tick. The mortality in man runs from 50 to 90 per cent.

Although it has already killed several workers in the U. S. Public Health Service, the Hygienic Laboratory is on its trail, seeking a method of immunization or cure. The work is in charge of Dr. R. R. Spencer, who is regarded by his fellow workers, themselves used to dealing with such unpleasant diseases as plague, smallpox and typhus, as literally on the firing line of science, for the unseen bacteria are more deadly than enemy bullets and give no warning until their victim is stricken down.

FAMINE THREATENS BIRDS OF NORTH

Science Service

FAMINE threatens the animals and birds of the northern forests, if the signs observed by scientific naturalists are to be credited. Creatures furred and feathered, which ordinarily winter in the sub-Arctic wilderness, are working their way southward, seeking food. The long-continued drought is held responsible for extraordinarily small crops of evergreen cones, which are a chief dependence of the winter birds and the squirrels. Moreover, a scarcity of mice and rabbits is suspected.

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As a consequence of these conditions the small birds are moving, and the owls are following them. The fierce goshawk, the great gray Arctic owl and the horned owl, when deprived of a supply of mammals, also turn to the little birds for food, and they, too, promise to descend into regions which ordinarily they never enter. A similar famine several winters ago brought great flocks of small birds, crossbills, nuthatches, pine grosbeaks, tree sparrows, creepers, woodpeckers, purple finches, chickadees, snowbirds, juncoes and other hardy species, which ordinarily find living easy in the icy wilderness northward. They were much in evidence in the country neighborhoods and in the suburbs and parks of New England cities. They were accompanied by the owls and the goshawk, which levied toll on the henyards and game as well as upon the birds.

Edward Howe Forbush, director of the division of ornithology of the Massachusetts Department of Agriculture, in a statement just issued points out as "a most significant event among the birds" the movement of red-breasted nuthatches, which began in Maine and the Canadian provinces in August and has spread over southern New England and probably farther south. This movement, he says, indicates a scarcity of cones in the north, no doubt the result of a dry season. If this scarcity is a fact, a southward movement of pine grosbeaks, crossbills and other boreal birds may be expected. Mr. Forbush continues:

"Large flights of birds are coming down through northern New England where wild fruits and cones are scarce. They are stripping the wild cherry trees of their fruit. Red squirrels have appeared in numbers in northern Vermont, and are stripping the pine trees of their cones. They are said to have come in from Canada and to be moving southward in search of food. All this as well as an early flight of owls indicates famine in the north. There must be a scarcity of rabbits and of mice in the north. A marked migration of owls has taken place in the woods of northern Ontario. Small owls were seen in the day time and many great horned owls were hooting at night. Since then horned owls have been reported in southern New England."

INVISIBLE METAL WIRE

Science Service

SCIENTISTS at the Bell System Laboratories of the Western Electric Company have found it possible to make gossamer-like metallic strands as fine as 200-millionths of an inch in diameter.

These copper-nickel wires are being used in the construction of the vacuum thermocouple. Practically invisible to the eye as they are, it is found necessary to weld them together under the microscope for enclosure within the minute vacuum bulbs.

The American thermocouple was one of the many "war babies." Prior to the war thermocouples came from Germany. When that crisis involved cutting off the supply from abroad, the Western Electric Company began experimental work.

Thermocouples are required to adjust circuits in the vacuum tube repeaters on long-distance telephone lines. In general these tiny glass bulbs are used to measure the small alternating currents in telephony and radio. The wires made up from a copper-nickel alloy used in fuses to protect the thermocouples are passed through an electrolytic acid bath where they are eaten down to the size desired, it being impracticable to draw wire through dies as fine as is necessary.

Both copper-nickel and tungsten wires are used in this laboratory. The tungsten threads are the smallest of all, being only 200-millionths of an inch thick—a good one hundred of them would be required to make one wire the size of the hair on your head.

Before the development of the electrolytic process, it was exceedingly difficult and expensive to draw the tungsten wire to sizes less than 500 hundred thousandths of an inch in the laboratory. Smaller! smaller! has been the cry until this wire which the eye can hardly discover even under strong light with the aid of a microscope has been evolved and can be produced easily.

MUSIC AND EMOTIONAL EXPRESSION

Science Service

CANNED music is not new; but canned thrills, extracted from canned music and preserved as an aid in the study of human emotion may follow from recent work done by Dr. C. E. Seashore, head of the department of psychology at the Iowa State University. He has been making a study of the expression of emotion in music and concludes that since everything in the way of musical expression that is conveyed to the listener comes in terms of the sound wave, and since these sound waves may be recorded, measured and analyzed by instruments of precision it is possible to get a perfectly accurate record of what the musician conveys.

These factors may then be reproduced separately and their emotional effect combined, making "an approach which is extraordinarily promising for the scientific study of the expression of musical emotion."

It has been found, for example, that the appealing vibrant quality in a singing voice, known to musicians as "the vibrato," is a combined pulsation of pitch and intensity averaging about six oscillations a second. It can, therefore, be expressed in terms of three variable quantities, pitch or frequency of the sound wave, intensity or loudness, and time. Within these three factors all possible variations of emotional expression possible to the vibrato may be found.

A similar method of study may be applied to the emotional effect of timbre which gives the characteristic quality to sounds of all character, and to tempo and rhythm.

The possibility is indicated of the detection of counterfeit emotion through a study, preferably from photographic records, of the voice or musical tone, and here a note of warning is sounded to flirts and flappers. For, says Professor Seashore:

"A tender emotion is a condition of nervous instability. With the objective facts in hand we can correlate the vibrato with principles of neural discharge, showing

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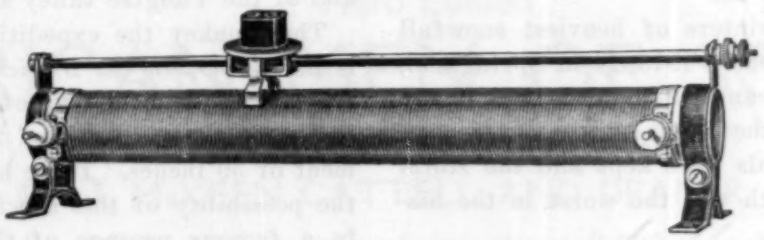

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the relation of artistic expression in music to nervous instability. We may investigate the relation of a feigned emotion or a genuine emotion, according as the music was or was not expressed emotionally.''

The study so far has been made chiefly through phonograph records which incidentally offer a valuable method in this connection for the study of emotional elements of primitive music.

SNOWFALLS

Science Service

''WHERE are the snows of yesteryear?'' is a question that has long agitated not only the poets but the oldest inhabitants who are fond of telling of what happened in the good old days. The question is answered in part by Clarence J. Root, meteorologist of the local office of the U. S. Weather Bureau, who states that records show in nearly all sections of the country just as heavy recent snowfalls as those which occurred a generation or more ago.

He also declares that just because snowfall in some sections may have been light during the past few years it doesn't follow that there is not going to be much this winter. There may be as much or more.

The only place whose record gives comfort to the oldest inhabitant, Mr. Root says, is Boston, where the snowiest winter in Weather Bureau records was that of 1873–74. Portland, Maine, made its record in 1886–87 but came within half an inch of equalling it last winter when roads were impassable for motor traffic from New Year to the end of March. Throughout the northeast generally there have been but six winters in which more snow fell than during that of 1922–23.

In the middle west the winters of heaviest snowfall were 1909–10 in Columbus, Ohio; 1913–14 in Springfield, Ill.; 1885–86 in Cheyenne; and 1916–17 in Salt Lake City. January, 1918, was the most severe month ever known in Illinois since records were kept and the storm of the eleventh of that month was the worst in the history of the state.

So Mr. Root concludes that there will be undoubtedly in the future storms and snowy winters like those in the past, snows which will enable the oldest inhabitant fifty years hence to say: ''We didn't have mild winters like this when I was a boy.''

THE "LOST TRIBES" OF CHINA

THE National Geographic Society announces the sending of an expedition into remotest China to search for human traces of east Asia's history before the Chinese came, to hunt for specimens of a monkey believed to be the largest non-anthropoid species in the world, and to collect botanical specimens in a spacious region virgin to scientific study.

Kweichow, where the mysterious non-Chinese tribes of China dwell, is the objective of the expedition. This province, about the size of Missouri, with a population estimated at 8,000,000, is as inaccessible as Tibet. It is the least fertile, least visited, and most backward portion of China.

Yet the strange tribes which suggest that some ethnic circus troupe was stranded there make Kweichow a possible vista of hitherto unrecorded human history. One of the few visitors among these tribes, who makes no claim to being a student of anthropology, said he saw types resembling the Gurkha, the South Sea Islander, the American Indian, the East Indian and the Negro.

It may develop that some or all of these strange tribes constitute the American Indians of China. Another writer says that the process of Chinese absorption has been going on among them since 2356 B. C.!

Between two and three million of the non-Chinese populace survive. Many of their strongholds never have been visited by white men; whole tribes did not know the world war was in progress. While China was stirred by the Shantung problem because the Chinese feared encroachments in the province of Confucius' tomb, these tribes were oblivious of any ''Shantung problem,'' though they may retain the vestiges of a culture, spread over the whole of southern China in the days when Confucius taught.

Occasional travelers who have penetrated villages of some of these tribes tell how one of them thrashes grain on the roof tops as in the Holy Land; how others have great ''prayer flags'' flying on fortified castles; and how quarrels are settled on horseback with blunderbusses, broadswords and bags of stones as the weapons in these curious jousts.

Kweichow has escaped zoological collectors, although it holds hope of many animal prizes. It lies on the watershed between the Yangtze and the West River. Its northern mountains are a continuation of the Tibetan system. Therefore the faunas of Indo-China, of the mountains, and of the Yangtze valley should meet within its borders.

The monkey the expedition particularly hopes to find is the *Rhinopithecus Brelichi*, of which the only evidence now available is the skin of a female which shows a head and body measurement of 29 inches and a tail measurement of 39 inches. There has been speculation regarding the possibility of this species being an animal described in a famous passage of Chinese literature as follows: ''Its nose is turned upward, and the tail very long and forked at the end; whenever it rains, the animal thrusts the forks into its nose. It goes in herds and lives in friendship; when one dies the rest accompany it to burial. Its activity is so great that it runs its head against the trees; its fur is soft and gray and the face black.''

Going directly to Peking, Frederick R. Wulsin, leader of the National Geographic Society expedition, will first take with him into Kweichow a Chinese botanist and a staff of Chinese assistants for a reconnaissance. Later he will be accompanied by a party comprising botanists, zoologists and anthropologists. The last named will study the origin, physique, habits, language and rich mythology of the non-Chinese tribes which vary in all these respects from their Chinese neighbors.

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because clouds kept a group of scientists from taking pictures of an eclipse of the sun brings up questions of sunshine and cloudiness in various parts of the United States, which may run into dollars and cents at other times than during occasional eclipses.

Just as there is a "population center," a "wealth center" and a "geographical center" of the United States, so there is a "sunshine center" and a "cloud center."

Most of the familiar "centers" lie east of the Mississippi River, but the country's "sunshine center" breaks this precedent and is situated in the extreme Southwest, near the mouth of the Colorado River. Yuma, Arizona, furnishes the dot on the map on which to place a compass and draw the circle into which the sunbeams pour almost ceaselessly during daylight hours. Only 18 days in the average year can be called cloudy in Yuma and in a roughly circular area about 100 miles from the city in every direction.

Considering the length of the days as well as their number, the region around Yuma and embracing the southwestern third of Arizona gets 85 per cent. of all the sunbeams aimed at it during the year, while 80 per cent. of all the sunshine that could be received hits the mark in the southeastern end of California, practically the whole of Arizona, southwestern New Mexico and the little sharp westernmost point of Texas around El Paso.

Sunshine runs into dollars and cents in this region because the line of "80 per cent. sunshine," or perhaps the slightly larger 75 per cent. line, may be said to enclose the section of the United States which sells its climate on a year-round basis to thousands of tourists, out-door enthusiasts and health-seekers.

Nature has given compensations for a lack of sunshine. As the percentage of fair days grows less and less outward from the "sunshine center," the rainfall grows greater and greater, so that agriculture may flourish without irrigation. But after the mouth of the Mississippi has been passed, the sunshine lines double northward, putting southern Florida practically into the 75 per cent. sunshine area. Here again sunshine means dollars and cents for Miami and Palm Beach and their fellow resorts.

The "cloud center" of the United States is in a little region in western Washington near the southernmost indentation of Puget Sound. Half the days there are cloudy and an additional 30 per cent. are partly cloudy. About the little center is a large area of only slightly less marked cloudiness.

In the region around the country's "cloud center" there is another sort of dollars and cents compensation. The cloudiness in this case is accompanied by heavy rain and snowfall and these, with the high mountains of the region, furnish the ingredients which give the State of Washington a greater potential water power than that of any other state in the Union.

There are two secondary "cloud centers" in the east. On the southeastern shore of Lake Ontario and in the Upper Peninsula of Michigan, between Lakes Superior and Michigan, three quarters of the days in a year are either cloudy or partly cloudy.

ITEMS

Science Service

DIPHTHERIA among school children could be largely eliminated through preventive immunization of children of pre-school age who have been shown by the Schick test to be susceptible to that disease, said Dr. Frederick W. Sears, N. Y. State health officer for Syracuse and near-by counties, in an address before the American Public Health Association at Boston. This might be brought about through proper cooperation between parents and physicians, the bringing before them by the proper authorities of the great value and benefit of the Schick test and the immunization of children shown to be susceptible to diphtheria infection. Testing the children and subsequent immunization was a task better performed by private physicians than by the state.

RHEUMATISM is the principal cause of chronic heart disease, Dr. C. V. Craster, of Newark, N. J., told members of the American Public Health Association in convention at Boston recently. He said organic heart disease was a serious menace to America, causing about one seventh of all deaths. It is on the increase and has already superseded tuberculosis as the principal cause of death. Dr. Craster advocated more adequate hospital treatment for rheumatic patients, and popular education as to the danger of heart disease following rheumatism, tonsilitis and chorea during childhood. The highest death rates from organic heart disease are to be found in the States of Vermont, New Hampshire and Massachusetts, while the lowest reported rates are from Montana, Mississippi and Tennessee.

ICE has been reported in the Atlantic near the Azores at a point 600 miles further east than any that has been seen this year. The report was made to the Hydrographic Office by the Dutch steamer Djambi, officers of which relate seeing a piece of ice 30 feet long and standing about a foot and a half out of water in latitude 40 degrees 10 minutes and longitude 31 degrees 36 minutes. This is within 75 miles of Corvo, one of the westernmost of the Azores. The ice was evidently the last remnant of an iceberg that had been carried far to the east by the Gulf Stream before melting.

DR. CHARLES F. MARVIN, chief of the United States Weather Bureau, calls attention to the growing error in the present or Gregorian calendar, adopted by most of the civilized world more than three centuries ago. The error, which amounts at present to 468 thousandths days, is due to the fact that the calendar assumed the length of the year to be 365.2425 days, when it is really 365.24231545 days and growing shorter by about half a second a century. The present calendar omits three leap years in 400 years. Dr. Marvin suggests that it be continued until 3200 A. D., when the error will amount to nearly one day, and that subsequently five leap years in 600 years be omitted. Such a calendar would run until the year 17600 with an error of less than one day.

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SCIENCE NEWS

CALIFORNIA EARTH MOVEMENTS AND EARTHQUAKES

Science Service

SLOW movements of the earth's crust are in progress in California, Colonel E. Lester Jones, director of the U. S. Coast and Geodetic Survey, who characterized them as "remarkable," reports to Science Service. The eventual result of the precise surveys showing these changes may be the prediction of the time and place of earthquakes within reasonable limits.

Field parties this year found irregular movements of the coastal region within 200 miles of San Francisco amounting to as much as 16 feet as compared with accurate surveys made 30 or more years ago.

The discovery of the movements was made possible by the survey's field operations under special congressional appropriations, and the cooperation of the Seismological Committee of the Carnegie Institution of Washington, headed by Dr. Arthur L. Day. The field work consisted in the redetermination of the latitude and longitude of certain peaks, principally of the Coast Range, and of certain lighthouses, the positions being determined by reference to two massive peaks of the Sierras, Mount Lola and Round Top. The actual measurements were made by two triangulation parties, one under C. L. Garner in 1922 and one this summer under F. W. Hough.

The movements shown bear a general relation to the famous San Andreas fault line, a slip along which was the immediate cause of the great earthquake of 1906. Points south and west of this line have with a few notable exceptions moved in a northerly direction; while those to the north and east of the line have nearly all moved toward the south. There is little uniformity in the amount of the movements.

For example, San José peak, about ten miles southwest of the fault line and about 40 miles inland from San Luis Obispo, has moved north 16 feet while Santa Lucia peak, 80 miles to the northwest, has moved only 7 feet northwards.

Near San Francisco bay the differences in direction are most marked. The lighthouse on South East Farallon Island has moved westward 6 feet, while Point Reyes lighthouse, on the mainland 18 miles away, has moved 11 feet to the north. Mt. Tamalpais has moved south about 5 feet.

Loma Prieta peak, about 50 miles southeast of San Francisco, has moved southeastward 6½ feet, while Sierra Moreno peak, about half way to San Francisco and on the opposite side of the fault line, has shifted 3 feet to the westward.

Major William Bowie, chief of the Division of Geodesy, under whose direction the work during the past two years has been done, says of the results:

"They are epoch-making and may lead to the eventual predicting within reasonable limits of the time and place of earthquakes. They will certainly have great influence on geologic thought in the study of the earth's crust. The remarkable thing is that the peaks do not move the same amount for any given direction, the complicated movements seemingly indicating the action of local forces rather than one of a world-wide origin.

"The results have much interest and value to the engineer, the surveyor and map maker, the geophysicist and the geologist. It has long been known that the earth moves horizontally along a fault line, but how far back from the fault does the movement take place? Our surveys found decided movements for stations 15 miles or more from the fault and the creeping of the surface probably is going on at even greater distances. Field work carried on in the future will reveal this. I believe the theory of isostasy must be taken into account in the explanation of what is going on in California and in other active earthquake regions."

MERCURY ENGINES

Science Service

THE first mercury engine in the world for the production of power in commercial quantity is now in operation in the plant of the Hartford Electric Light Company, whose officials predict a saving of from 40 to 50 per cent. of fuel by its use. The invention is essentially a turbine engine run by mercury vapor. The whole electrical industry is interested in observations being made of its operation.

Incentive for a careful investigation of the properties of mercury vapor for power generation is given by the high cost of coal and its transportation, making it necessary to minimize fuel consumption. The mercury boiler was started successfully at Hartford early in September and has since been in regular operation, carrying a part of the commercial load of the local lighting system. Officers of the local lighting company say that it has carried approximately 3,500 K. W. of the Hartford load.

While the present installation is not of sufficient size to have any effect on total cost of power produced by the company at the present time, it is large enough to provide a working basis to calculate the results that may be obtained eventually from larger sizes. The manufacture of these boilers is so intricate that it will probably be several years before the larger boilers can be in operation.

It is expected that the mercury boilers will be a very material improvement over the most modern stations, even those contemplating using 1,000 and 1,200 pounds of steam pressure. The new process will require only about one quarter of the fuel that is used with the best reciprocating engines.

The mercury vapor exhausted by the mercury turbine is sent to a condenser where it is cooled by water, just as in any ordinary power system. But the mercury vapor is so hot that the "cooling water" is turned into high-pressure steam. This steam is not wasted, but is sent to a steam turbine from which additional power is obtained. This still further increases the efficiency of the system.

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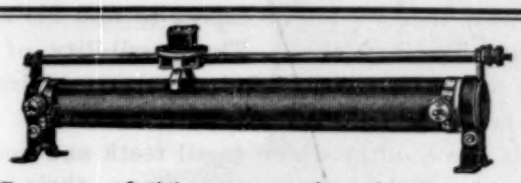

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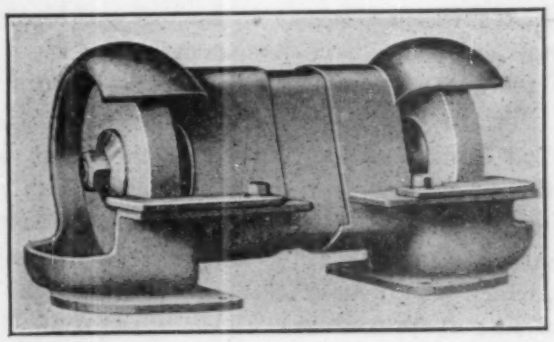

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In this connection it is of interest to recall that the Hartford Electric Light Company installed the first commercial size steam turbine in this country.

A SCIENTIFIC FUR FARM

Science Service

A NEW experimental fur farm, stocked in part with unscented skunks, has just been established by the United States Biological Survey on a twenty-acre tract of wooded land in Greenfield Township, Saratoga County, New York. F. G. Ashbrook, of the Bureau's Division of Economic Investigations, has charge of the transfer of the animals from the former and more inaccessible site at Keeseville.

Present plans call for a series of modern pens to accommodate silver, black and red foxes, martens, minks, fishers and skunks. The breeding habits of these fur bearers will be studied and methods of combating disease among them will be worked out.

At Keeseville last year martens were successfully bred in captivity for the first time. This work will be continued at the new site and efforts will be made to discover how to breed the fisher, another beautiful fur animal which has hitherto baffled the commercial raiser.

Experiments in fighting disease, such as distemper and hookworm, will be carried forward. Hookworm is one of the most prevalent diseases among captive foxes, and the bureau has worked out an effective means of killing the parasites which produce it by use of the chemical, carbon tetrachloride.

Much trouble was formerly had in administering this remedy, however, as the capsules in which it was given were often broken in the mouths of the foxes with the result that the carbon tetrachloride was liable to go down their windpipes, causing suffocation. Recently the investigators found that by use of a more gelatinous capsule, which would mash without breaking, this trouble could be largely prevented. Methods of artificial respiration, similar to those used to revive an apparently drowned man, were also worked out by which the accidentally gassed foxes could be resuscitated.

The skunks raised on the farm have all had their scent sacs removed. This gland operation does not injure the breeding or fur value of these animals which have been held in such bad odor, but makes them more agreeable from an olfactory standpoint.

CHINESE FOSSIL MAMMALS

DR. W. D. MATTHEW, curator of the Department of Vertebrate Paleontology of the American Museum of Natural History, has published in the *Museum Bulletin* a description of the fossil material collected by Walter Granger, the paleontologist of the Third Asiatic Expedition, during his first season in China. The collection covers a series of skulls and innumerable jaws, bones, teeth or other fragmentary material of many kinds of animals, probably of late Pliocene age. *Stegedon*, an extinct proboscidean intermediate between mastodons and elephants, is the largest animal present; a rhinoceros related to the living Indian species, a gigantic tapir about the size of a horse, a "buffalo" related to the Gaur of India, a large pig, larger and smaller deer and antelopes of several kinds, are the chief hoofed animals. The carnivora are represented by a tiger, a hyena, a "parti-colored bear" (*Aeluropus*), a sun-bear, sand badger, a "wild dog" (*Cyon*), and a civet; the primates by a langhur and a new genus allied to the gibbon; while a large bamboo-rat, very abundant, is the sole representative of the rodent tribe. There are no horses, no true dogs, and other animals of the open plains are conspicuously absent, so that the collection is believed to represent the fauna that then inhabited the forests and foothills of south China. Some of the animals or their descendants still survive in south China, some have retreated to India or the Malay states, while other races have become wholly extinct.

According to the views held by some of the best authorities on the ancestry of man, it is in just such a fauna as this that we might expect to find his ancestors of the late Tertiary time. The possibility of such a discovery was well understood, but as yet nothing of the kind has been found in China.

China is one country where fossil teeth and bones have a considerable value, quite aside from their scientific interest. Fossils have been used as fertilizer, it is true, where they occur in cave deposits, or rich pockets, and have been ground up and used for their phosphates. But in China they have quite another use as medicine and have been mined for centuries to supply the Chinese drug-shops with "dragons' teeth" and dragons' bones," a regular article of the Chinese pharmacopœia. There are, it appears, four ways of administering them. They may be ground to powder in a mortar and eaten raw. Or they may be ground and fried with oil in a skillet. Or the powder may be stirred up with sour wine and either drunk off fresh or the mixture left to settle, decanted, and the clear liquid drunk. They are specific for certain nervous diseases, heart troubles and disorders of the liver. Without recommending the remedy for adoption in this country, it is perhaps permissible to point out that mixing with sour wine would result in a combination of bicarbonate and acid phosphate of lime that might really have some medicinal value—just what, may be left to physicians to decide.

Packets of the fossil teeth or bones were purchased in the drug stores by travelers in China and sent to paleontologists in Europe. They were reported to have been brought down the rivers by traders, but it is only in the

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Nitrogen	13.66	water, fat, ash-free	15.44

(cf.—Osborne & Harris, Jr. Am. Chem. Soc , 25-IV. 346)

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past few years that the principal localities where they are mined have been discovered, mainly through the activities of Dr. J. G. Andersson, geological adviser to the Chinese Government. Dr. Andersson has made collections at some of these localities and secured fine series of complete skulls of Pliocene and Pleistocene animals. Other localities he has very generously handed over to the American museum explorers, and Mr. Walter Granger spent two winters on the Upper Yang-tse-Kiang collecting fossils, chiefly at a locality near Wansien in the province of Sze Chuan. The fossils are found in fissure deposits in the limestone rocks, and the Chinese have sunk pits into these fissures in the richer pockets, sometimes to a depth of a hundred feet, using crude ladders and handmade windlasses that remind one of the mediæval mining methods described by Agricola and other early writers.

FISHERY PATROLS BY SEAPLANE

PEOPLE have grown accustomed to hearing of the use of aeroplanes in survey work, forest protection and other land work, but the successful carrying out of air patrols of the fishing areas of northern British Columbia by the Royal Canadian Air Force during the past season has opened up a new field for aircraft with many unique features. So successful were the experimental patrols instituted in July by the Department of Marine and Fisheries in British Columbia that it was decided to continue the patrol until the end of September. The introduction of the seaplane patrol resulted in greatly increased efficiency in the work of detecting breaches of the fisheries regulations and much better observance of the laws.

The seaplane and its crew engaged in the work were stationed at Prince Rupert and trips were made north, south and inland of that point. The work of the patrol included the detection of irregularities in the use of gill-nets; a sharp lookout during the closed period between 6 P. M. Friday and 6 P. M. Sunday; a constant watch to see that fishermen keep outside the boundaries of the mouths of rivers and inspection of the exposed parts of the coast which are inaccessible to the patrol boats.

As a result of information supplied by the patrol several fishermen were prosecuted for adding what is known as "handy billies" to their gill-nets. The regulations allow the use of gill-nets 200 fathoms long. However certain fishermen added small nets or "handy billies" 50 to 75 fathoms long, with little fear of detection owing to the inability of the patrol boats to keep close watch on all the nets. From a height of 3,000 to 4,000 feet in the air, the seaplane observer can count the corks, set three feet apart, and note any excessive length. During the closed periods from Friday to Sunday, the seaplane can do the work of twenty patrol boats, it is estimated, while in checking up delinquent fishermen who fish within 400 yards of the mouths of streams and rivers, the speed with which the seaplane arrives on the scene after it comes in sight prevents the offender from raising his nets and concealing what he has been doing.

Exposed portions of the British Columbia coast which can not be inspected by the patrol boats owing to the waters being uncharted were visited by the seaplane. The area covered by the patrol extended from Cape Caution, on the north end of Vancouver Island, to the Alaskan boundary, while periodical visits were made to operations on the Naas and Skeena rivers, Douglas channel, Gardner canal, Dean and Burke channels, and the Portland canal. Distances were covered in a few hours by the seaplane that would have taken a number of patrol boats days to accomplish, and as a result of the great expanse patrolled it was found possible to reduce the number of boats by four.

ITEMS

THAT natural gas gasoline may be used to advantage as a refrigerant is asserted by L. D. Wyant, chemical engineer of the Bureau of Mines who has recently completed an investigation of its possibilities in those lines. In the experiments conducted it was shown that a temperature in a "cold room" of 14 to 16 degrees above zero Fahrenheit was easily obtained. Natural gas gasoline has the advantage over ammonia, the commonly used refrigerant, in that its vapors are not poisonous in low concentrations, while those of ammonia are dangerous in the concentration of half of one per cent. It requires less pressure than when liquid carbon dioxide is used as refrigerating agent, and produces more cold than does liquid sulphur dioxide, which also is poisonous. These advantages are believed to offset its inflammability, as danger from that source may be avoided by ventilation. It is asserted that a concentration of gasoline vapor equivalent to a fatal concentration of ammonia would not be inflammable.

WHEN it comes to an example of industry in the brute creation, man should no longer consider the ant, but the gopher, according to Professor Joseph Grinnell, of the University of California, who has been making a careful study of these little animals. As a result, he has estimated that in Yosemite National Park alone they bring to the surface from their burrows enough dirt to fill 160 freight cars of 50 tons each, and that in so doing they expend 5,500 foot-tons of energy. Dr. Grinnell has many kind words to say for the gopher, which is generally considered as a pest by western farmers. He declares that so long as the busy little digger stays on wild, uncultivated land he is performing a useful part in the economy of nature. He turns over the soil to a depth of about six inches, helps to keep it fertilized, counteracts the packing effect of large animals on grazing land, and, by making the soil porous, helps to minimize danger from floods. Dr. Grinnell estimates that there are a billion gophers and other burrowing rodents in California alone.

THE last surviving members of the Chemakum tribe of Indians have been discovered living in one of the old villages of the Clallam tribe along the straits of Juan de Fuca. They are an old man and his sister of about the same age. They have forgotten nearly all their own language, but Professor Franz Boas, of Columbia University, succeeded in 1890 in extracting 1,200 Chemakum words from them. It is believed that centuries before white men came to Puget Sound the Chemakum inhabited the whole northern part of the Olympic peninsula and were a powerful tribe.

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SCIENCE NEWS

WATER FROM BURNT GASOLINE IN AIRSHIPS

Science Service

THE cruising radius of airships, such as the great navy dirigible *Shenandoah*, will be greatly increased as a result of an invention now approaching completion as the result of months of study by the government's aeronautical and scientific experts. The device makes it possible for the ship to burn up its store of gasoline without loss of weight and without increase of buoyancy. This will result in the saving of many thousands of dollars worth of the expensive helium gas that lifts the ship and which otherwise would have to be released and wasted in the air to keep it from rising to dangerous heights.

The principle employed is simple. It involves the condensation of the water vapor resulting from the burning of the gasoline, and the retaining of it in the craft as ballast.

Gasoline is composed of carbon and hydrogen. When burned, the products are carbon dioxide, carbon monoxide and water vapor. The first two gases escape. The last is condensed. Since gasoline requires more than three times its weight of oxygen for complete combustion and since about a third of that goes to form water, the weight of the condensed water is somewhat greater than that of the original gasoline.

This keeps the weight of the airship constant and makes unnecessary a loss of the lifting gas, which heretofore has been a feature of long flights. In an airship without the condensing device, the craft grows lighter as the voyage progresses owing to the consumption of the liquid fuel. This results in the airship rising higher and higher until in the interest of safety some of the buoyant gas has to be liberated. This reduces the reserve buoyancy if unfavorable conditions are met, and so curtails the length of flights.

Airships of the future equipped with the compensating water condensation device will be able to carry up fuel in quantity only limited by the buoyancy of the craft and the requirements of space, and will be able to burn it without releasing a compensating quantity of the precious helium gas.

Water condensation apparatus will be installed on the *Shenandoah*, formerly the ZR-1, before long flights through the polar regions or elsewhere are attempted, according to present plans of the government experts. If the airship of commercial type, the ZR-3, which is now being built for the United States by the German government, is successfully delivered to this country, it also will be equipped with the new invention.

VAPORIZED METAL

Science Service

BRONZE covered statues, copper-covored shingles, concrete piles, or railroad ties, and gold covered furniture are some of the possibilities ensuing from a process for spraying metals, which after years of study is approaching perfection at the U. S. Bureau of Standards. An exhibit showing stone, cement, metal, wood and glass which had been coated by the new process attracted wide attention when shown by the Bureau in the recent Chemical Industries Exhibition in New York.

The essential of the process is that the metal is first vaporized and then sprayed on to the surface to be coated by means of a powerful blast which congeals it to the solid form as quickly as it strikes the surface. Details of the process are withheld by the bureau at present for military reasons, except for the statement that it is based on a new principle and that electricity is used in the vaporization process.

Applications of the method, which results in a firm coating of metal upon any surface to which it is applied, are many and varied. Stone, wood, metal and glass are all equally suitable basic surfaces. Pottery may be successfully coated with metal, pointing to important developments in the ceramic industries.

An important application is in the use of the metal coating in building construction. Shingles may be made fire resisting by coating them with copper, which weathers well and produces an artistic green color on the roof. Experiments are already being made along the lines of copper coating other roofing material and stucco.

Soldering of metal to glass, a difficult problem, has been easily accomplished by means of this method. The glass is first coated with a layer of copper and the metal connection is then soldered to the copper. Processes somewhat similar are used in the soldering of aluminum.

The preservative qualities of metal-coated articles are attracting attention from many quarters. It may be used in airships, and is being experimented with as a marine paint for naval vessels, certain alloys being highly resistant to salt water corrosion and inhospitable to the growth of barnacles. For the same reason it may be used to protect piling and its preservative action may also be used to conserve railroad ties.

On the decorative side the uses of the method are many. Statues or other sculptured designs may be hewn from soft and easily worked stone and then coated with bronze, giving the effect of a bronze statue and weathering equally well. Gold plating or decoration may be applied in the same way to furniture or table ware.

A coating of copper one thousandth of an inch in thickness may, so its inventors say, be applied at the rate of two square feet a minute and at a cost of two cents a square foot exclusive of the cost of labor. Cheaper and more easily fusible metals such as lead would cost less.

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Bureau of Science, **Manila, P. I.**

and tropical climates. A long series of experiments on workers in hot mines has shown that a small quantity of salt daily has the power to relieve the men of much of the exhaustion supposed to be due to severe toil at high temperatures and to prevent altogether the development of the dreaded miners' cramp. Men given about one third of an ounce of common salt dissolved in a gallon of water reported themselves stronger and fitter in every way.

The experiments were carried out under the direction of K. Neville Moss, professor of coal mining at Birmingham University. They showed that during work at high temperatures men lost an abnormal quantity of salt through the perspiration. Since salt is an essential constituent of the blood, Professor Moss thought it likely that the cramps and nervous symptoms due to excessive heat and work might be alleviated or prevented by administering salt to the workers and the results have justified his theory.

Measurements showed that during a five and a half hour working shift at a temperature around 100 degrees, the men lost from nine to eighteen pounds through perspiration and respiration. This was not a net loss, as during that time they consumed an average of seven and a half pounds of water. Other men who worked in a specially heated testing room in a laboratory showed similar losses and a loss of about twice as much salt from the system as would occur under normal conditions.

It has long been known that the drinking of large quantities of water while at work was apt to cause cramps among workers at high temperatures, but this had been attributed to local causes in the stomach. Professor Moss believes it to be due to the washing out of the essential salt from the blood and to confirm his theory points to experiments on animals in which similar symptoms have been caused by forcing large quantities of water down their throats.

He also discovered that men who worked in hot mines showed a greater taste for salt food than those who worked under normal conditions, the average consumption of salt being a third greater among the former class. Another surprising fact brought out was that the workers in the hot mines ate more food of all sorts than those who worked where it was cool. The reason for this he says is not clear, but it may be due to the extra work put on the sweat glands.

It was also shown that the ability to sweat freely is acquired by practice. Men not accustomed to mine work who were put through the tests did not perspire anything like as much as experienced workers, while one of the latter after a vacation was several days getting back his perspiratory pace.

THE SANTA BARBARA SKULL

Science Service

ANTHROPOLOGICAL experts of the Smithsonian Institution expect that scientific investigation by men trained in bone study will prove that the age of the supposedly primitive skull found at Santa Barbara, California, has been greatly overestimated. This expectation is based on long experience covering numerous finds of so-called primitive man on this continent.

Photographs and a complete report of the discovery of this so-called "Santa Barbara" man are expected by the Bureau of Ethnology of the Smithsonian Institution in a few days. A telegram received from J. P. Harrington, language expert of the bureau, who made the find, described it as of "primitive type" and in a statement alleged to have been made by him in Santa Barbara he is quoted as attributing to it greater age than the famous Neanderthal cave man of Europe.

The Neanderthal man lived, it is estimated, more than 25,000 years ago. The earliest human remains so far found in America date back only about three thousand years. This earliest American was found at Leland Stanford University.

According to Dr. Aleš Hrdlička, curator of physical anthropology of the Smithsonian Institution, his division has for years investigated numerous reported discoveries of remains of prehistoric people of supposedly great antiquity. Only last month the bones of a race of prehistoric dwarfs were reported from New Mexico. Upon examination the bones proved to be merely those of young children. Leg bones of mastodons and other prehistoric elephants have even been attributed to a race of human giants by discoverers with a great deal of imagination.

In 1916, near Vero, Florida, remains were found which for a time were thought to be those of a very primitive type of human being. Painstaking study led to the conclusion, however, that these bones were of the modern Indian type. Some skulls known to be those of Indians who have recently died show pronounced sloping of the forehead and high bony ridges over the eyes which the uninitiated might easily mistake for the European cave-man type.

Before leaving for the West, Mr. Harrington declared that the Indians had been on this continent for 20,000 years. He based his estimate largely upon the differences developed in various Indian languages. The bone experts have found nothing to confirm the theory that Indians have been here so long.

THE HEARING OF PHEASANTS

Science Service

Do pheasants and other birds hear sounds which are inaudible to human ears? That is a question brought up by Dr. Charles Davison, leading seismologist, in a discussion of the distances at which great explosions may be heard. Pheasants during the great war showed evidence many times of being greatly disturbed by air waves resulting from explosions or naval battles which were not heard by human beings, and their behavior has thrown light on the problem of the so-called "zones of silence" around great detonations which beyond these zones are again audible.

These "inaudible sound waves" cause the pheasants to crow, scream and flutter about as if greatly frightened. Such behavior was observed at many points in England at the time of the naval battle of the Dogger

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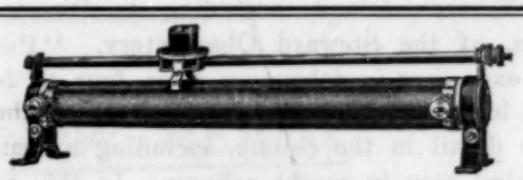

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Bank on January 24, 1915. At a distance of 216 miles from the action, pheasants "shrieked themselves hoarse" and smaller birds were terrified, although not a sound was heard by human ears. The greatest distance at which the birds were affected was 320 miles. The same effect was produced by the explosion of Zeppelin bombs, the birds reacting to explosions 80 miles away, beyond ordinary human earshot.

In some cases people did hear the noise of the cannonading 200 miles or more away, but if this were on the far side of a silent zone the pheasants were affected a little before any one heard a sound, indicating that the inaudible waves traveled a little faster than those which were heard. But if the point of observation were on the near side of a silent zone, the audible waves arrived first. It is suggested that the inaudible waves travel across the silent zones close to the ground, while the waves which are heard farther on make a detour upwards across the zone and arrive a little later because of their longer course.

Just what effect these "silent waves" have on pheasants is not known. The theory that they "hear" them is opposed by the fact that the audible waves produce no effect upon the birds. The inaudible waves are of long wave length and set up vibrations in loose articles, and it is thought more likely that the birds are frightened by the quivering of the branches upon which they may be resting.

BEAVER FARMS

Science Service

BEAVER farms to test the practicability of raising these famous fur animals in captivity on a commercial scale have been started in southern Michigan, according to Vernon Bailey, chief field naturalist of the U. S. Biological Survey. Two sites were stocked with beavers and experiments begun which will probably take three years to complete, but which may result in making valuable considerable areas of now unproductive land.

Efforts will be made to determine the proper number of beavers to an acre of land, the effects of large numbers on the health and increase of stocks, breeding habits and similar information important to the commercial fur farmer.

Although these rodent engineers are capable of doing considerable damage by felling trees, building dams and flooding land and killing timber, Dr. Bailey believed that by placing them on unproductive fenced lands they may be made to yield substantial returns in an annual fur harvest.

During the summer Mr. Bailey also perfected a trap to catch the beavers alive in water. Beavers caught in these traps near Lake Superior were transported by rail to the two farms in the southern part of the Michigan peninsula. Losses were experienced due to the fear and nervousness of the animals in transit.

A hundred years ago the beaver was America's leading fur animal, and it played an important part in the development of vast regions in the West and North. Beaver skins were once the unit of value in the traffic between white trappers and the Indians.

Unrestricted trapping later threatened the complete extinction of the beaver, but in the last twenty years under protection they are now returning to many parts of their former range. A great part of their original range is now under cultivation.

ITEMS

Science Service

SEPTEMBER had the lowest death rate ever recorded for any month in the history of the Metropolitan Life Insurance Company, according to figures given by Dr. Louis I. Dublin, statistician. The death rate among the industrial policyholders of that company was only 7.1 per 1,000 per year. Figures for the third quarter of 1923 just compiled also show a record for that period, the death rate of 7.4 being the lowest recorded for those three months of any year. Automobile fatalities continued to increase, showing a rise of 11 per cent. from last year's figures. On this basis, Dr. Dublin considers it probable that the total deaths in the United States from this cause during 1923 may reach the high number of 15,000. Deaths from tuberculosis and typhoid fever continue to show substantial decreases and are expected to establish new low records. Alcoholism in Dr. Dublin's compilation accounted for 323 deaths during the first nine months of the year as compared with 293 for the whole of 1922.

SUCCESSFUL photographs of the recent total solar eclipse (September 10) were obtained by the University of Arizona Expedition which went to Port Libertad, on the east coast of the Gulf of California, sixty miles north of the Tiburon Island, according to Director A. E. Douglass, of the Steward Observatory. "Pictures of various exposures in telescopes from four to forty feet in focal length were obtained. These show prominences and fine detail in the corona, including a coronal arch of the kind seen in recent eclipses. In this case, however, the arch is somewhat dim as though seen through much thickness of intervening matter." Dr. Douglass headed a party of nine that had to travel by automobile over roads which had been badly washed out by summer rains which were still in progress. At the observing station on the coast the sky overhead and to the west was clear, while heavy storms hung over the mountains to the east. Most eclipse expeditions in California were total failures on account of cloudiness.

OBSERVATIONS of Professor G. H. Peters, of the U. S. Naval Observatory, show that a new sun spot period has started. New periods begin with the appearance of spots in the high solar latitudes far from the sun's equator and such spots have already been noted. According to tentative calculations, the time of sun spot minima was reached in the latter part of February. Electrical disturbances such as have been frequently associated with increase in sun spots occurred during the past month. Whether such disturbances are connected with the sun spots can not be stated definitely. The number and size of the spots will gradually increase until a maximum is reached, and then the number will begin to fall off. It takes on the average a little over eleven years for the spots to complete this cycle.

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SCIENCE NEWS

THE CAUSE OF CANCER

Science Service

THAT cancer is in some cases and may be in all cases due to irritation set up by parasites of microscopic size, the irritation acting upon an organ or organs unable to withstand it because of inherited or acquired weakness, is the judgment of Dr. Erwin F. Smith, chief plant pathologist of the U. S. Department of Agriculture and vice-president of the American Association for Cancer Research. His opinion is the result of a long review of the present knowledge of cancer.

Dr. Smith attracted great attention from students of the cancer problem a few years ago when he demonstrated that the crown gall of plants, a disease closely paralleling animal and human cancers, could be experimentally transmitted from plant to plant by means of pure cultures of a microorganism and that the symptoms were due to substances excreted by the parasite. Since then he has continued his work and has now become convinced that human cancers are in all probability due to parasitic infection, even though no parasite causing human cancer has as yet been found.

Dr. Smith also calls attention to a long series of experiments by others, showing that cancers can be produced experimentally in animals in several ways and that one of the most important of these ways is by means of parasitic infection. Cancers in fowls have been shown to be not only transplantable but the liquid expressed from the ground tumor contains a virus which will cause cancers, when injected, and this virus persists in cells killed by heat, cold or drying. Cancers in the stomach of rats and in various organs of frogs have been found to be closely associated with parasitic nematodes, which are microscopic worms. The rat parasites pass the first part of their life cycle in the muscles of cockroaches, the frog parasites in angleworms. The animals in eating the cockroaches or the angleworms become infected with these nematodes, and frequently cancerous growths ensue. Another cancer in the rat, sarcoma of the liver, is due to the larval stage of a tape worm of the cat. Finally, cancers have been produced in mice by painting the body with irritating substances such as coal tar.

"Whatever we may think of the cause of human cancer," says Dr. Smith, "it can not be denied that these experiments have so much advanced our knowledge and have so simplified the problem that we may hope for its full solution, so far as regards many forms of cancer, in the not distant future. I believe that the bulk of the evidence points to microparasites as the probable cause of sarcomas and carcinomas.

"Opposed to this view is the fact that no one has isolated any microparasite; but these negations do not disturb me because the parasites of tuberculosis, of leprosy, of syphilis, of malaria and of yellow fever remained undiscovered for many years.

"The fact that human cancer does not appear to be contagious should not bulk very largely against this view. Malaria is not directly transmitted from person to person and yet it is due to a parasite. Human carcinoma may perhaps require an intermediate host and it almost certainly requires for its growth a defective bodily condition, either a bad inheritance or a long continued bad environment, or both acting together."

Referring to experiments with rats which showed marked inherited tendency to cancer, but only if the exciting parasite were present, Dr. Smith said: "A long continued physiologically wrong course of living, excessive eating or drinking, or chewing or smoking, might also be regarded as preparing a suitable soil for cancer, but hardly as the direct exciting cause. What occurs here may be the premature aging through excessive stimulation of some of the protective organs of the body. We must abandon the idea that cancer is only a disease of old persons. At any age, however, I believe it to be only the last stage in a series of physical degenerations. Probably no one can have cancer who is not ripe for it. Here is a great field for fruitful study.

"Heredity alone can not cause cancer, but irritation, either parasitic or possibly non-parasitic, plus heredity can and does cause it. No such conclusions could possibly have been drawn twenty years ago. They are the measure of the progress we have made."

Finally, Dr. Smith makes a plea for more money for cancer research:

"It is unfortunate that so little money should be available. Rich men offer large sums for cancer cures only to be overwhelmed with fraudulent claims, but the men and women who are devoting their lives to researches likely to throw light on the problem and working desperately hard are left to get along any old way. I know several places in this country where a few thousand dollars is very much needed and would help cancer research amazingly."

THE HEAT OF THE STARS

Science Service

NEW differences between stars, hitherto unsuspected by astronomers, have been pointed out by Dr. C. G. Abbot, of the Smithsonian Institution. The discoveries, which were made at Mount Wilson Observatory, California, in analyses of the heat reaching the earth from ten different stars, are expected to open up a new field of astronomical investigation.

The ten stars used in the inquiry were the blue star, Rigel; the white stars, Vega and Sirius; the light yellow star, Procyon; the yellow stars, the Sun and Capella; the light red star, Aldebaran; and the red stars, Betelgeuse, Alpha Herculis and Beta Pegasi.

The method employed was that used for the first time by Dr. Abbot last year, by which the star light is broken up by the prisms of the spectroscope into a band of visible color and other waves, and then the heat in the different parts of the band detected and measured by means of the Nichols radiometer, an extremely delicate

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device which is worked by heat on the same principle as the little vanes often seen spinning in jewelers' windows.

The work was undertaken merely as a "stunt," Dr. Abbot said, to see just what could be done in carrying star heat measurements further than ever before. It was expected that the heat from the stars of the same color type would be greatest in the same parts of their spectrum, and that the variations would occur in much the same way as they do in the Sun, which has been most thoroughly studied.

It was found, however, that there were surprising differences as to the parts of the spectrum from which the greatest heat came even in stars which have been classified as belonging to the same type. The blue star, Rigel, had two widely separated positions in the spectrum from which the greatest heat was received. One of these was from the visible rays of light and the other from the infra-red or the waves longer than those which are seen in the visible spectrum.

Dr. Abbot states that "the full significance of these findings can not be known until measurements of the heat of a large number of stars are obtained, but they do indicate that they differ from one another in more ways than we have thought and open up a new and complex branch of investigation of great promise. What we now need is greater refinement in measurements to get more and fainter stars. Our present apparatus, by which we measure not only the heat furnished by the stars seen as twinkling points of light in the sky, but the heat furnished by the different parts of that light, can detect a hundred millionth of a degree. We must get refinements which will enable us to measure a thousand millionth of a degree."

OIL-BEARING SAND

Science Service

MINING of worked out oil sands by methods resembling those of coal mining is now on a commercial basis in Europe and may possibly be profitably applied in some American oil fields, according to George S. Rice, chief mining engineer of the U. S. Bureau of Mines, who recently returned from a study of European mining conditions. Where it has been tried, the new process permits the recovery of as much oil as was originally taken out of the wells, he said.

The process is a German invention and was started by the Germans during the last year of their occupation of Alsace during the war. It was applied to a shallow oil field, the sands 500 to 750 feet deep, at Pechelbronn, near Strasbourg, which had been worked more or less for a century by the usual method of drilled wells. Getting into successful operation about the time of the armistice, the whole plant was taken over by the French when they came into possession of the province and has since been worked by a French company. The German company which opened the Alsace mine has started a similar enterprise in an oil field near Hanover.

The essentials of the process are the sinking of regular mine shafts to the level of the oil sands and the driving out of "levels" or working tunnels at right angles to the shaft, and inclined cross-cuts dividing the oil layer into rectangular blocks 100 feet or more in size. The levels are driven to a slight rise and at their ends or "faces," and also at the faces of the cross-cuts, the oil sand is quarried out by pneumatic picks, loaded into mine cars and hoisted. Oil exudes from the side of the passageways and flows by gravity in ditches down the inclines and along the levels to sumps or pits where it is moved on by pumps to a general sump for the entire mine. Here it is lifted to the surface by an ordinary oil pumping well.

A further stage in the process which would take from the sand all but the last trace of oil is now being worked out, although not in commercial operation. It involves the actual lifting of the oil sand to the surface as ore, and the extraction of the remaining oil from it. Details of this operation are still in the experimental stage.

The chief danger from this novel method of oil mining is from fire. It is not applicable to new fields because of the presence of gas which must have been tapped by wells and the pressure reduced to that of the atmosphere before the sands can be safely mined. The present enterprise has suffered at its start from one bad fire due to sparks ignited by falling drill steels in a shaft, and setting fire to the oil and gas in the shaft sump, which at that time was the collecting reservoir. To avoid this, the reservoir sump has been moved to another location, and the oil is pumped through a bore hole direct to the surface. Although there is no pressure of gas there is a certain amount of gas given off constantly, requiring strong ventilation to remove, as in a gaseous coal mine.

Mr. Rice is conservative as to the application of this method to use in oil mining in this country, pointing out some of the difficulties involved. He believes that the oil sands must not be at a depth of more than 1,000 or possibly 1,200 feet, as below that the cost of shafting would be prohibitive. Most of the oil fields in this country are much below that level. The oil sand must be practically free from water, which is the case in the field in Alsace, but which is not the case in many fields here where the oil is pushed up by underlying artesian water. It has been suggested that there are certain fields in Oklahoma where the method might be tried, and the old field around Oil City, Pa., offers interesting possibilities.

The usual methods of drilling wells for oil recovers only about 30 per cent. of the oil in the oil sand. The remainder adheres to the sand particles. The new method, where it is applicable, recovers 30 per cent. more, leaving about 40 per cent. which may be in part recovered if all the sand can be mined and brought to the surface and extracted.

TESTS ON NET PRESERVATIVES

Science Service

MILLIONS of dollars may be saved to the fishing industry of this country by tests on net preservatives now being made at the U. S. Bureau of Fisheries. The experiments include a comparative study of the protecting

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power of various chemicals on cotton, linen and hemp netting exposed in salt and fresh water and in the air.

The annual fish catch of the nation is valued at $80,000,000, but Dr. Harden F. Taylor, chief technologist of the bureau, has pointed out that about $14,000,000 is invested in webbing and lines and that most of these nets probably last less than two full seasons. The rapid rotting of the lines is believed to be due largely to minute aquatic organisms which secrete a substance which dissolves the cellulose in the fiber and so causes its failure.

The principal net preservatives have apparently come into use without scientific inquiry as to their value. Tanning extracts which preserve skins have been applied through false reasoning to cotton and linen lines which are chemically very dissimilar substances.

The present investigation was begun to determine what preservatives are best for any given fiber under different conditions of exposure. Lines impregnated with the various chemical preservatives are being exposed in the water at Beaufort, North Carolina; Key West, Florida; Woods Hole, Massachusetts; Put-in-Bay, Ohio, and Washington, D. C. At intervals these lines are returned to the bureau where their tensile strength, flexibility, wearing quality, increase in weight, shrinkage, resistance to fouling and color are tested on machines especially designed for the purpose.

Copper oleate, never before used as a net preservative, has been found to be the most effective of the chemicals tested in salt water, while coal tar has furnished the best treatment for nets designed for use in fresh water.

Preservatives tested were coal tar, pine tar, coal and pine tar mixed, two proprietary petroleum products, quercitron and potassium bichromate, the Dutch tanning method, copper oleate, copper paints, a proprietary waterproofing compound, and two combinations of copper oleate and coal tar.

THE ELIMINATION OF NOISE

Science Service

WORK being done by the U. S. Bureau of Mines is pointing the way toward the elimination of one of the greatest nuisances and annoyances due to modern industry, the detonating explosions of blasting and quarrying operations. The noiseless quarry is not far in the future and persons living near will not have to worry about their windows and ceilings when the noon blast is shot.

"The existence of a nuisance is evidence of an economic waste," is the epigrammatic expression of the whole problem by Dr. Charles E. Munroe, inventor of smokeless powder and chief explosives chemist of the bureau, under whose direction the solution of it is being worked out. In the case of blasting explosions the nuisance is the noise, and this he explained was a clear case of waste.

"The noise is due to the use of a wastefully large quantity of explosive," he said, "and to poor methods of tamping the charge. The ideal blast would contain only enough explosive to break up the rock, and if properly tamped would be almost noiseless; certainly inaudible at any considerable distance.

"These severe detonations which one may hear nowadays where blasting operations are being carried on are excellent as fourth-of-July demonstrations for those who enjoy that sort of thing, but from the economic standpoint they are a great loss. A large part of the present cost of blasting goes for noise. By saving the noise a great deal of money can also be saved, and mine and quarry operators are coming to realize that fact."

Dr. Munroe referred to the great amount of work which has been done towards using the by-products of industry which formerly went to waste and caused nuisances in the neighborhood. This was especially true in the packing industry, the offal from which, formerly thrown into near-by streams, is now made profitable and useful.

"You can't make it too emphatic," he repeated. "The existence of a nuisance is evidence of an economic waste."

ITEMS

Science Service

A NORMAL winter, neither unusually cold nor mild over the eastern half of the United States, seems more probable than an exceptional season, says Dr. Charles F. Brooks, professor of meteorology at Clark University and secretary of the American Meteorological Society, as a result of studies made of the temperature of the Gulf Stream and adjacent waters during the past several months. The dry, stormless summer was due, Dr. Brooks says, to a relatively cool Gulf Stream and accompanying high air pressure over the western Atlantic. The Gulf Stream is now showing signs of warming up a bit, but the warmth will be only temporary and of a moderate character, and a continuation of the relatively quiet weather of the past several months is looked for during the winter season. This, says Dr. Brooks, means that there is no basis for expecting a winter out of the ordinary in eastern North America.

DUPLICATE copies of all charts, sailing directions, light lists and miscellaneous publications of the U. S. Hydrographic Office are being forwarded to the Japanese Hydrographic Office by order of Secretary Denby. Information has been received that the Japanese office with all its equipment was totally destroyed in the fire following the recent earthquake. In announcing this action, Captain F. B. Bassett, hydrographer of the navy, stated that he had been in daily conference with Captain Osami Nagano, the Japanese naval attaché, concerning the rehabilitation of the Japanese Hydrographic Office in which the American navy would play an important part "cementing the bonds of friendship which so happily exist between the American and Japanese navies."

ICELAND is using refrigeration this year for the first time in her history in the exportation of large quantities of mutton, formerly salted and barreled.

RADIO messages broadcast from Los Angeles, Salt Lake City and Chicago were recently received daily by engineers of the U. S. Geological Survey while traveling in the bottom of the Grand Canyon of the Colorado.

THREE American buffaloes have been given to the Mexican Government by the United States.

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SCIENCE NEWS

METEORIC SHOWERS

Science Service

EVERY year from about November 13 to 27 meteors in unusual numbers may be expected due to the appearance of two periodic showers, the Leonids and the Andromedes, named for the constellations from which they appear to radiate.

To see the Leonids one must be up before sunrise about this time and look in the general direction of "The Sickle" in Leo which will be seen in the eastern heavens at five o'clock in the morning. It is not possible to predict how great a display one will see because the intensity of the swarm varies from year to year. The Leonids are traveling in an orbit that crosses the earth's orbit at a point which our planet passes through about November 15 each year. The meteors, which are merely the dust of a disintegrated comet, are not evenly distributed around the orbit but are more or less bunched. Every thirty-three years exceptionally dense swarms of Leonids are to be expected. Such swarms appeared in 1833 and 1866 and would, doubtless, have occurred in 1900 if the great planet Jupiter, the mischief-maker of the solar system, had not chanced to be in a position to greatly perturb their motion and throw them out of their course.

The Leonids are noted for their rapid motion relative to the earth, their intense blue or bluish-green color and their brilliant, persistent trails. In the early morning hours we are on the "fore" side of the earth as it advances in its orbit and so we meet the Leonids "head on." This accounts for their rapid motion with respect to the earth. In the evening hours we are on the "following" side of the earth and so the meteors we meet then are the ones that overtake the earth. As a result, swarms of meteors that are met in the early evening hours are characterized by sluggish motions, reddish color and trails that soon fade away. Such are the Andromedes that appear in greatest numbers about November 24, but which may be seen any time between the seventeenth and the twenty-seventh. They can be observed only in the early part of the night as they come from the direction of the constellation of Andromeda, which will be found a little to the east of the meridian in the early evening in the latter part of November. That the meteors appear to radiate from a definite point in the heavens which is called their "radiant" is simply a matter of perspective. In reality all meteors are moving in nearly parallel lines in their orbits as they cross the orbit of the earth.

The minute, dust-like particles of which a swarm of meteors consists do not in general weigh individually as much as a single grain. They would appear merely as a cloud of dust reflecting the sunlight if we could view them outside of our own atmosphere. It is only the friction produced by their passage through the earth's atmosphere that raises them to luminescence.

These shooting stars, as they are sometimes misleadingly called, are always noiseless in their flight. In this respect they differ from the large meteorites or fire-balls that rush through our atmosphere accompanied by loud explosions and intensely brilliant flashes of light, finally falling to the surface in small fragments or large masses weighing a number of pounds or even tons. The small particles of which these periodic swarms consist are completely consumed by friction soon after entering the earth's atmosphere. It is probable, however, that both the noiseless meteors, or shooting stars, and the noisy meteorites have a common origin and are but fragments of comets that have gradually become disintegrated and scattered along their orbits.

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MAGNETIC OBSERVATORY IN NORTHERN GREENLAND

Science Service

THE northernmost magnetic observatory in the world has just been established by the Carnegie Institution of Washington and the Macmillan Arctic Expedition at Refuge Bay, northern Greenland. The beginning of observations by R. H. Goddard, of the institution's staff, is announced in a relayed radio message from Donald Macmillan, leader of the expedition, to Dr. Louis A. Bauer, director of the department of terrestrial magnetism of the institution.

The observatory consists of an especially designed wooden building encased by a snow house to protect the instruments from temperature changes. Its location is 550 miles north-northeast of the magnetic north pole and some 700 miles south of the geographic north pole, in latitude 78 degrees, 3 minutes north, and longitude 72 degrees, 27 minutes west. The taking of observations there is part of a comprehensive plan for a world-wide study of the intensity and variability of the mysterious force which causes the compass to point either east or west of true north to an extent depending upon the position of the observer. The data collected may also throw light on any possible connection between these variations in the earth's magnetism and northern lights, sun spots and "static" which often interferes with radio communication.

The building which houses the instruments for making continuous photographic records of the variations of the magnetic elements and the variations of the atmospheric electric potential gradient is especially designed to preserve a constant temperature. Its parts were made in Wiscasset, Maine, and assembled on the present site in the far north, where the observations will probably be made until the expedition returns to this country next September.

The importance of data in regard to the earth's magnetism is indicated by the fact that while all our commerce on the seas is largely dependent upon the compass, the compass can not be safely used in navigation unless it is known how much the needle is deflected from

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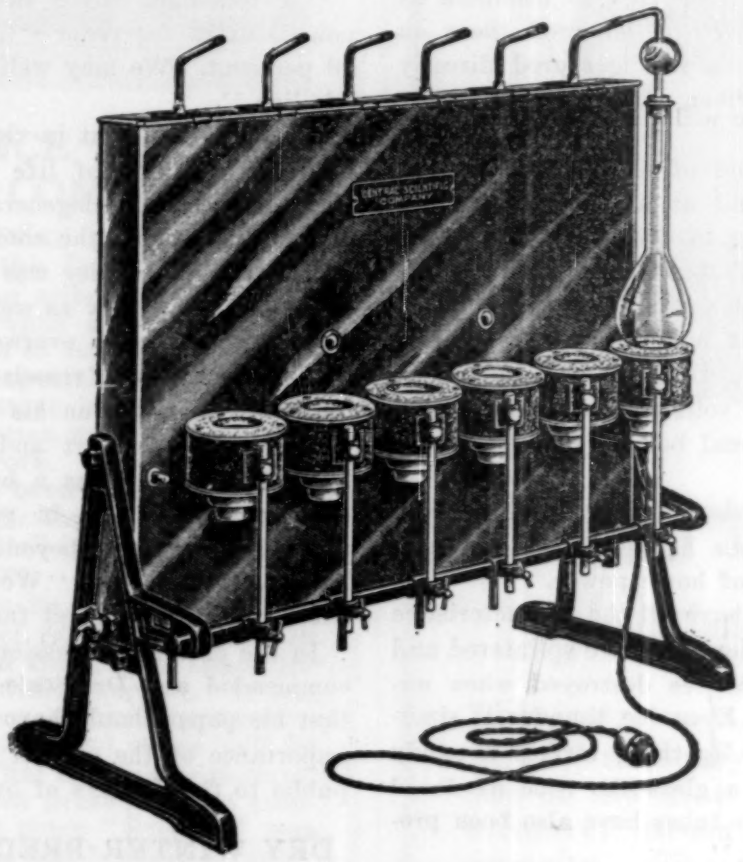

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the true north. In sailing from Alaska to San Francisco, for instance, a ship might be some distance west of California toward the Hawaiian Islands if allowance were not made for the changes in compass direction.

THE VOLTAGE OF THUNDERBOLTS

Science Service

SCIENCE has measured the thunderbolt. The voltage of an average lightning flash has been determined to be about 100,000,000 volts, Dr. F. W. Peek, Jr., engineer in charge of the General Electric Company's high-tension laboratory at Pittsfield, Mass., reported to members of the Franklin Institute in a lecture delivered there on November 15. The voltage was not measured directly but by comparison with phenomena observed in the study of artificial lightning.

It was found that when one of these made-to-order thunderbolts struck the ground at a distance from a transmission line corresponding to a real lightning flash at a distance of 1,000 feet, that a voltage of approximately one per cent. of the flash was induced in the transmission line. Measurements of induced voltages in real transmission lines following lightning flashes show them to be of the order of 1,000,000 volts; hence the deduction is made that the force of a real bolt is 100 times that amount.

The lightning generator devised by Mr. Peek for the investigation of these problems has produced as much as 2,000,000 volts at millions of horse power.

"Bolts from the generator have all the characteristics of real lightning. Large wooden posts are splintered and blown apart and miniature houses destroyed when unprotected by lightning rods. Even the thunder is simulated. When a bolt of real lightning strikes a sandy place its path is defined by a glass-like tube of fused sand called a fulgurite. These tubes have also been produced with artificial lightning."

The purpose of these investigations was to find means of remedying the danger to high-power transmission lines from lightning strokes near-by. It is not necessary for lightning to strike such a line to cause trouble. A lightning stroke a mile away may cause very high voltages in the line by induction, and these induced strokes, which travel over the line with the velocity of light, are in fact the cause of most of the trouble. In order to study these effects a model section of country was constructed with transmission line, cloud and lightning stroke all built very accurately to scale.

THE DANGERS OF FAT

Science Service

"EAT, drink and grow fat, and to-morrow you die," according to Dr. K. H. Beall, of Fort Worth, Texas, who spoke on this subject recently before the Southern Medical Association. Excess fat is a parasite which saps the health and strength of its victims and predisposes them to disease and to premature old age.

"We are all acquainted with the lean, long-waisted individual who spends his life in trying first one treatment and then another in a vain effort to get fat. He ought to be thankful to be able to remain thin. If tuberculosis doesn't get him before he is 40 he is reasonably sure to live to old age and finally to succumb not to any particular disease but rather to a general sort of mild decay.

"Time was when fat was an asset to a man. It was a valuable reserve to carry through periods of famine. The need for it has been banished by civilization."

Men of middle age who are more than 25 pounds overweight have an expectancy of life of only 15 years as compared with an expectancy of 35 years in thin people, he continued.

"A four-inch excess in a man's waist line and 25 pounds extra fat reduces his probable length of life by 40 per cent. We may well say that a man's belt is his life line."

Dr. Beall said that in view of the fact that there had been no extension of life after middle age for a century, and that the degenerative diseases were nearly all due to overweight, the complacency of the medical profession toward obesity was inexcusable. Laymen understood the risk nearly as well as doctors did.

A man 30 pounds overweight carries around 25 miles of additional blood vessels to nourish and maintain the "excess baggage" on his person, and this extra strain is the cause of heart and kidney breakdowns in later life. Overweight was a handicap in all infectious diseases and especially in pneumonia; and fattening of tuberculous patients beyond normal was condemned. As for diabetes, he said, "We may well say that to get diabetes you must first get fat."

In the ensuing discussion, Dr. Beall's conclusions were commended and Dr. Seale Harris, of Birmingham, said that his paper should have wide publicity because of the importance of the subject and the need of arousing the public to the dangers of overweight.

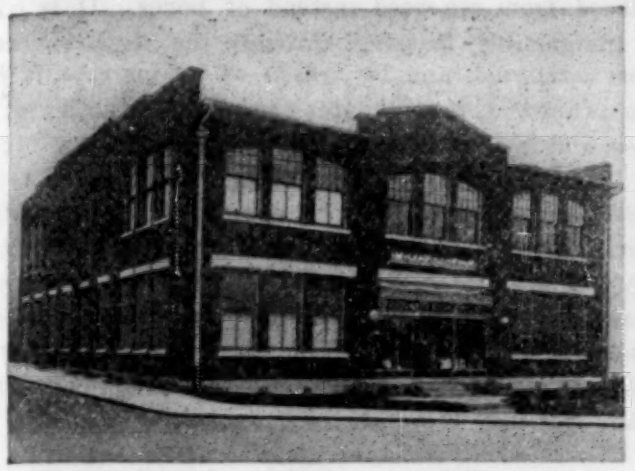
DRY WINTER PREDICTED IN SOUTHERN CALIFORNIA

Science Service

TOURISTS who expect to visit Southern California this winter may expect an unusually dry winter season if the forecast of Dr. George F. McEwen, of the Scripps Institution for Biological Research at La Jolla, is verified. As the result of studies made on the relation between the temperature of the ocean water during the late summer on the rainfall of the following winter, he predicts a deficit of from 20 to 30 per cent. in the precipitation during the coming season.

Cold ocean water means that more rain than usual may be expected, while warm water along shore in the late summer means a lack of rainfall inland during the usual rainy season. The water temperature the past summer exceeded that for any summer of the past seven years and indicates a rainfall in the lowlands of Southern California this winter of only 8 inches as compared with a normal of from 10 to 12 inches.

Investigation has shown that the cooling of the water along shore is present at all seasons, but especially so in the summer when it is due to the winds blowing out of a center of high atmospheric pressure far at sea, whip-



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The corporation owns its building at Lancaster, Pennsylvania, over 14,000 square feet of floor space lighted on all sides, with space for printing a hundred scientific journals. It has the best obtainable presses, composing machinery and binding equipment and these will be increased as needed. What is more important, it has the most competent pressmen and compositors in a city which since "Science" was first printed there in 1894 has become a center for fine scientific printing. The costs are only about three fourths as much as in the large cities.

The capacity of the office is shown by the circumstance that "Science," "School and Society," "The Scientific Monthly" and "The American Naturalist" were transferred to it on July 1 without the least delay or difficulty. The typography and presswork of these journals will bear comparison with any weekly or monthly publication in the United States or elsewhere. Those authors who have read proofs will know the correctness of the composition. A distinguished scientific man writes to the editor of "Science": "I corrected my first proof a year before you were born and the one I returned yesterday was the first one in my long experience that needed no correction."

Only a limited number of publications can be accepted at present as the business of the office will not be enlarged beyond its ability to do the best work with promptness. All correspondence should be addressed to the general manager, A. E. Urban, The Science Press Printing Company, Lancaster, Pa.

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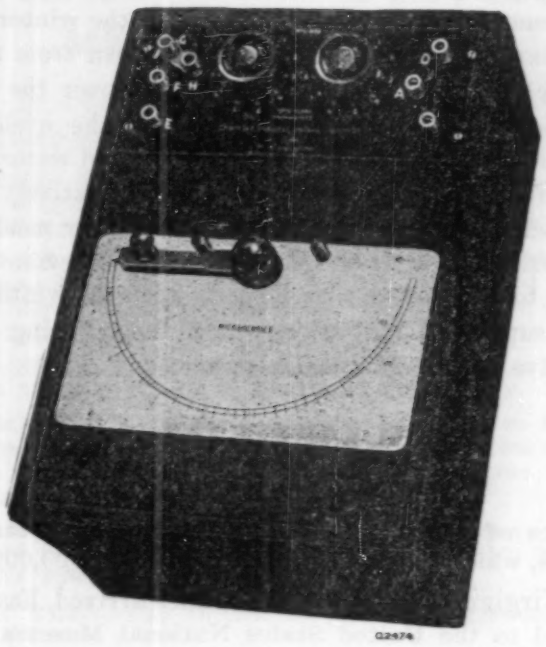

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ping away the relatively warm surface water and permitting the upwelling of the cold water from the depths of the sea. The temperature of the inshore water is thus a measure of the strength of the high pressure area hundreds of miles at sea.

But the intensity of this distant area of heavy, cool air is a big factor in winter rainfall along the coast, for from it must come the air which during the winter drifts inland, carrying with it the moisture drawn from the sea and which when chilled by the cold air over the winter landscape comes down as rain. Hence the cycle upon which Dr. McEwen builds his forecast. Cold water means high barometer and much rain, while relatively warm water such as has been observed this summer means just the opposite, a condition of dryness and sunshine disappointing to the farmer who depends upon the winter rains for his supply of irrigation water, but alluring to the prospective tourist and health seeker.

DINOSAUR TRACKS

Science Service

TRACKS of the long-legged dinosaur, with a stride of 56 inches, which roamed this region some 25,000,000 years before Virginia's famous first families arrived, have been presented to the United States National Museum by F. C. Littleton, who lives at President Monroe's old place near Aldie, Va.

Mr. Littleton is giving a prehistoric touch to his historic home by placing slabs containing other tracks of this ancient reptile in his front porch.

After examination of the tracks, Dr. C. W. Gilmore, paleontologist of the National Museum, said that they were probably made by one of the meat-eating species of dinosaurs. He deduced this diet from the sharpness of the claws evidenced by the imprints in the stone. The herbivorous forms had flatter, more hoof-like claws. The tracks of this three-toed monster, which apparently walked on its hind legs, were 56 inches apart. It has not yet been determined whether the reptile was running or walking, but further study and comparison with other dinosaur remains is expected to yield more exact information. The indications are that the animal was long-limbed.

This is the first time dinosaur tracks have been found in the state of Virginia. In reconstructing the porches of his house, Mr. Littleton wanted to get material like that President Monroe had used in the original structure, and suspected that these slabs were obtained from a quarry on the place. In digging the stones for the new porch, the dinosaur tracks were discovered. When the stones in the old porch were torn up, on the under side other dinosaur tracks were found.

ITEMS

Science Service

AGAR, the strange Japanese sea-weed jelly, formerly thought to be an exclusive product of the Orient, is now being produced in California commercially. Large beds of "gelidium," or jelly-producing sea-weed, have been discovered on the California coast, and the first agar factory of the western world has recently been established in Los Angeles. Agar resembles gelatin, but is produced from sea-weed instead of bones. It is edible but indigestible, passing through the digestive canal almost unaltered, and by reason of its increase in bulk when swallowed, it stimulates the muscular action of the bowels and is accordingly much used in medicine. It has long been a part of Japanese diet. The sea-weed is first cooked, forming a jelly which upon freezing loses all its water and can then be dried into a powder which upon mixing with water again assumes a jelly-like consistency. It has recently been reported that agar may be used as a basis for motion-picture film instead of the highly inflammable film material now used and its commercial possibilities may therefore be extended.

AIRPLANES will be extensively used in the continuation this winter and spring of the U. S. Navy survey of the south coast of Cuba, particularly the region of Batabano Bay and the Isle of Pines. Until the navy began the work last year there were no reliable charts of this coast and raw sugar from plantations in the neighborhood has had to be transported overland considerable distances because no vessels of any size dared risk the little-known channels. The U. S. airplane carrier *Wright* will accompany the survey ship *Hannibal* which will leave the Philadelphia navy yard on November 19. Several planes will be taken and the entire coast of this region will be photographed as a basis for charts. Photographs taken from an altitude of 10,000 feet will not only show the coast line but also the shoals at sea, which are clearly visible when viewed from a great altitude. The *Hannibal* is considered the best equipped survey vessel in the world, the equipment including the new sonic depth finder by use of which soundings can be taken while the vessel is under way. Two eagle boats will form part of the expedition as will two housed-over barges which will be towed from Key West to serve as living quarters for isolated surveying parties operating the eagle boats or smaller launches.

WITH the hope of possibly finding a basis for forecasting earthquakes in the Hawaiian Islands, the new U. S. scout cruiser *Milwaukee* is now making soundings of the depths of the Pacific to the south and southeast of the islands. The vessel is equipped with the new sonic depth finder and recently made a voyage to Australia during which soundings were made every few minutes while proceeding at full cruising speed. The work is being done under the direction of the Hydrographic Office and findings will be also reported to the Carnegie Institution of Washington.

PRAIRIE dogs in northern Arizona are eating most of the grasses which should support great herds of cattle, according to Dr. Walter P. Taylor, of the U. S. Biological Survey. At the rate these hungry rodents were eating forage on experimental plots they would have eaten grass enough on 50 sections of land to support 2,500 to 5,000 cattle, said Dr. Taylor. The prairie dogs have not a single beneficial food habit, nor are there any arguments against their eradication on all grazing lands.

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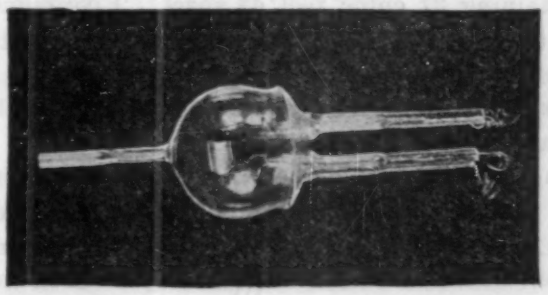

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SCIENCE NEWS

STIMULATION OF PLANTS BY ETHER

Science Service

No longer will useful plants be allowed to sleep out their long winter sleep if a discovery just announced to Science Service by Professor David Lumsden, of the Federal Horticultural Board, becomes the common property of nurserymen, amateur and professional gardeners and even farmers. For he has found that if given a "shot of dope," either by the inhalation or hypodermic method, they may be awakened as if by an alarm clock and set to their work of growing and producing flowers or fruit for the pleasure or profit of man.

The drug used in his experiments was the common ether of the hospital operating room, but instead of putting his plant subjects to sleep it woke them up. They liked it and seemed to thrive after just one treatment. For example, some plants were taken from outdoors in midwinter when they had to be dug from the frozen ground with picks, were given an overnight ether debauch and the next morning shoots of an average length of one eighth of an inch had sprouted. Kept indoors they continued to grow and flowers were produced weeks in advance of the usual blossoming season.

Roses were taken from the frozen ground and given a hypodermic injection of the same drug. Not only did they sprout and grow but, more important still to the indoor gardener, they were immune to all the ordinary plant diseases that make indoor rose culture a practical impossibility except in large greenhouses. Professor Lumsden has had roses in February, just six weeks from the time the plant was given its stimulating injection.

Only a very small quantity of ether is needed. In the inhalation method the plants are put in an airtight chamber containing 27 cubic feet of space. Five cubic centimeters of ether, or about a tablespoonful, are then introduced and the chamber sealed. Only about twelve hours exposure to the fumes is needed, and then the little plants are wide awake and growing.

In the hypodermic method Professor Lumsden made use of that sometimes formidable weapon, a woman's hat pin. With this a puncture about a quarter of an inch deep was made at the base of the stem of the plant where it joins the root. Then an ordinary hypodermic needle was introduced and half of one cubic centimeter of ether injected. This is the method which was generally used with woody plants such as roses or lilacs.

One of the important applications of this whole process, according to Professor Lumsden, is that using either method of drugging the plant, every single latent bud or shoot is brought to life. That is not nature's way, as usually only one of three or four ever grows. This may mean much in the culture of plants such as dahlias or potatoes which are grown from tubers. If every latent bud on these tubers could be made to grow they could be cut into smaller pieces and expense of seed saved. What is more, Dr. Lumsden believes that the plants would be more vigorous.

For he is working now to see if these ether treatments, especially the hypodermic sort, do not impart a lasting vigor to the plant, enabling it to resist disease. His experiments with roses strongly indicate this. If they are confirmed, ether "shots" will with plants take the place of the various forms of vaccinations to which the would-be healthy human is now subjected.

Finally, there is a mystery in this whole affair which science may some day solve, but of which it now knows little. Ether temporarily stimulates and then profoundly depresses all animal life. With plant life in moderate doses it is apparently all stimulation with no depression and no injurious after effects, but instead a lifelong increase in strength and endurance. If science can learn why this is so, much light will be thrown, Professor Lumsden says, upon the secrets of physiological growth.

THE WHALE'S SKULL

Science Service

THE speed at which whales are driven through the resisting water by their powerful caudal propellers causes the peculiar telescoping of the bones of their heads which has long puzzled scientists, so Dr. Gerrit S. Miller, Jr., chief of the division of mammals of the U. S. National Museum, suggests in a pamphlet just issued by the Smithsonian Institution. His explanation of the origin of this peculiarity as being purely mechanical is based on a study of the rapid swimming modern whales in comparison with their slower moving fossil relatives and with present day land and water mammals.

Whales were once land animals, but instead of the elements of their skulls joining evenly like those of the dog and other land mammals they are peculiar in that they show a highly developed system of "telescoping" by the slipping of one bone over another. The bone at the back of the head is forced forward and the bone which makes up the forward part of the face is forced backward over the central portion of the skull.

"With little doubt," Dr. Miller says, "this telescoping represents responses to stimuli which are in some way directly connected with the conditions under which these animals live."

Whales are born in the water and the young must acquire the ability to swim rapidly at an early age. There is no doubt that the habit of rapid swimming is established long before the skull has reached its full growth. The peculiar behavior of the skull may be connected with the fact that during much of that critical period in which the skull of an ordinary land mammal is rapidly and peacefully accomplishing its process of loose-jointed growth the skull of the young whale is fighting its way to adult size against the two opposing forces of body push from behind and water resistance from in front.

The Zeuglodonts, fossil cetaceans which were close relatives to the forerunners of modern whales, as well as sea-cows, have normal mammal skulls with no telescop-

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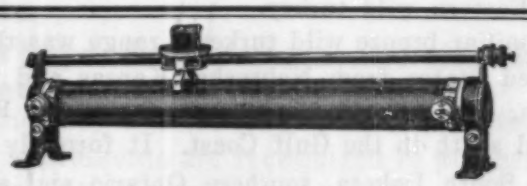

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ing of the bones. The resistance which water presents to a moving body increases as the square of the velocity, however, and if a whale swims three or four times as fast as a sea-cow its head will be subjected to from nine to sixteen times the backward pressure encountered by the head of the less rapidly moving animal. Sea-cows are known to be slow moving animals and that the Zeuglodonts of millions of years ago were less rapid than modern whales is evidenced by the fact they have smaller vertebral processes which serve as areas of attachment for the muscles that operate the tail.

TURKEYS FROM THE TROPICS

Science Service

WITHIN a few days a flock of beautiful occelated Honduras wild turkeys, collected in Central America by Harry Malleis, of the U. S. Biological Survey, is expected to arrive at New Orleans, according to Dr. T. S. Palmer, who is in charge of animal importations. These birds will be taken to Sapelo Island, Georgia, in the first attempt to introduce this tropical species into the temperate zone.

The Honduras turkeys are remarkable for their brilliant iridescent plumage. It is black tipped with brassy-green and fringed with greenish copper. The head is bright blue and yellow, and the rump region is steel-blue, with brilliant eyes of green-blue margined with copper marking the ends of the grayish tail feathers. It is said to be much more gaudy than the peacock, to be somewhat smaller than our eastern wild turkey, but to have even better meat.

Whether these turkeys can be successfully bred in this country will be determined on Sapelo Island. If these birds prove adaptable here, they may not only furnish a new game bird for sportsmen, but attempts to raise them in captivity will be made.

Experiments at zoological gardens indicate that this fancy bird will breed with our less colorful species. It is the only species of turkey, however, which is native to tropical lowlands. The Mexican turkey, from which our domestic turkey is believed to have originated, lives on the high table-lands. It has the characteristic white tipped tail feathers of the domestic bird.

Wild turkeys in Arizona and New Mexico show this feature, while turkeys of the Rio Grande valley of southern Texas are partly like the Mexican birds and partly like the Eastern wild turkey.

Our familiar bronze wild turkey's range was the eastern United States from Nebraska, Kansas and western Oklahoma, and eastern Texas east to central Pennsylvania and south to the Gulf Coast. It formerly ranged north to South Dakota, southern Ontario and southern Maine; but practically none are now found north of Pennsylvania and very few over much of the other part of its range.

QUARANTINE ON CHRISTMAS TREES

Science Service

THE old-fashioned Christmas tree will be scarce this year outside of New England, but if popular taste can be satisfied with substitutes there will be trees enough for everybody. The reason for the coming scarcity of the fragrant balsams and spruces which are so popular as Yuletide decorations is the quarantine which has recently been proclaimed by six states against all Christmas trees or greens shipped from any of the New England states, and the reason for the quarantine is to prevent further spread of the gypsy moth now prevalent over much of New England.

The bark of the little trees is a favorite spot for the gypsy moth to lay her eggs, where normally they live out the winter and hatch in the spring. Christmas trees are frequently thrown out on to dump heaps after the holidays and infected trees might therefore cause the introduction of the dreaded pest in remote parts of the country.

As the Christmas tree of commerce is the balsam or spruce, and as most of the supply of these trees has been taken from the forests of northern New England, the quarantine will create a scarcity of these trees in the states in which it is effective. These are Wisconsin, Michigan, New York, Pennsylvania, New Jersey and Maryland.

But even in those states there are good substitutes for the old-fashioned trees, according to Colonel William B. Greeley, chief forester of the United States. To a Science Service representative he stated that he "knew of no reason why the children should go without Christmas trees because of this quarantine. In the middle Atlantic states there is a large supply of scrub pines and cedars which make good decorative trees. New York has balsams and spruces of its own, and there is another stand in the Southern Appalachian forests."

Raising Christmas trees for the market has been made a successful business in some sections. Norway spruce is especially adapted for this purpose because it grows quickly, is decorative, and can be grown on light soils not suitable for farming purposes.

VARIATION IN CLIMATE

Science Service

THE Oldest Inhabitant may be right when he proclaims that "the weather wasn't like this when I was a boy." No less a scientific authority than Dr. Charles F. Marvin, chief of the U. S. Weather Bureau, in the course of a technical report on climatic changes, willingly gives the older generation its due and says in effect that science has in a way backed up some of its claims about a changing climate.

But these changes, Dr. Marvin says, are not permanent; merely "marked abnormalities which trend steadily in one direction and for many years away from that unchanging constant thing we may call the absolute normal climate." These trends may be as long as from 50 to 100 years in duration.

Rainfall records in New England going back nearly 200 years are given. These show that beginning about 1750 there was a more or less continuous and progressive diminution of rainfall for nearly 100 years, until in the middle of the last century it averaged several inches a year less than it did nearly three generations before.

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Then the tide turned and a progressive increase in New England rainfall is noted, culminating apparently in 1905, since which date there has been an irregular decrease. A somewhat similar change, although of an opposite character, is noted also in Padua, Italy, where records go back to 1720.

As the result of his mathematical study of these records, Dr. Marvin says he is inclined to believe that fluctuations in climate have occurred and that minor changes can and do take place over restricted areas for relatively long periods of time.

"The evidence submitted will," he continues, "tend to justify the deep-seated conviction in the minds of a great many keen observers of mature years that weather conditions at the present time differ in material ways from corresponding conditions easily within their memory. Our fathers and grandfathers probably entertained like convictions, and while memory and personal impressions can not be accepted as safe guides, it is probably wrong to assume that such generally prevalent convictions are fictions of the imagination.

"There may be some foundation of fact in the ideas of the oldest inhabitants on the subject."

ITEMS

Science Service

A COMPLETE scientific survey of the Red Sea and adjacent coasts is being undertaken by the Italian Government. Three well equipped vessels and a large corps of scientists have started for the scene of the work. This will include the preparation of hydrographic maps of the sea itself showing currents, tides and dangers to navigation. Airplanes will be used for surveys and for aerological studies. The geology and mineralogy of the country will receive much attention and especial emphasis will be placed on a study of the flora and fauna, particularly of the possible development of fisheries. Phosphate rock and potash are known to exist in the region west of the Red Sea and these resources will be more accurately estimated. A lighthouse and radio beacon will be established on Cape Gardafui.

GELATIN, regarded by many as useful only for the making of insubstantial desserts, is given a high place in the human dietary by Dr. Thomas B. Downey, of the Mellon Institute of Industrial Research, as the result of a long series of experimental feedings of gelatin to animals and human beings. It has been shown by these experiments to aid in the digestion of milk and to be of great value in infant feeding. Dr. Downey explains this action of gelatin by stating that it acts as a protective coating over the globules of fat and of casein in the milk, causing them to remain finely divided and so preventing the formation of tough, indigestible curds.

INSUFFICIENT sleep causes impairment of memory according to recent researches on the subject of sleep by Profssors Engelen, Frerichs and Weygandt. The memory becomes unreliable even if the shortage of sleep has occurred for only a short time. Eight hours is the average needed for sleep, but brain workers sometimes require more. A reduced period of slumber may be partly made up for by increased intensity, a short period of deep, undisturbed sleep having the same effect as a longer and lighter one. The investigators also conclude that brain workers need a month of rest every year and that even longer vacations do not cause a lessening of acquired abilities but rather an intensification of them.

THE Liverpool Tidal Institute is making calculations which may take the "moaning" from many a ship's "crossing of the bar." Scientists of that organization report progress in their attack on the problem of the effect of strong winds in increasing or reducing the predicted height of tides. With the great increase in the size of ocean-going vessels, navigation in inshore waters has become vastly more difficult and responsible than it used to be. There has been an increasing demand for more accurate prediction of tides. Otncers of large ships often find that meteorological effects are of great practical importance when they are preparing to enter or leave dock or cross a bar when the depth of water leaves a very small margin of safety. It is claimed that a strong wind blowing out in the Atlantic may alter the height of the tide in Liverpool harbor by one or more feet. The Liverpool Tidal Institute has done much since the last years of the war to give greater accuracy to tidal forecasts.

THE hum of industry sounds in the former homes of destructive prairie dogs of Douglas County in Colorado. Joseph Keyes, field representative of the U. S. Biological Survey in this district, has discovered swarms of bees going in and out of tne old chimneys of the vacated burrows of thousands of blacktails and heard buzzing in the enlarged cavities below, which gave him every reason to believe that the prairie dog homes had been converted into honey warehouses. The burrows were made vacant oy an intensive campaign of extermination directed by the government against these farm pests, which togetner with other rodents cause an estimated annual damage of over $300,000,000.

THE old belief that cattle are excited by the sight or the smell of blood has been dealt a severe blow by Professor G. M. Stratton, of the University of California. He has poured out buckets of blood before bulls, cows and calves without the animals showing more than mild curiosity. Cattle showed more interest in the blood of their own kind than in that of horses, but in no case was there any pawing o^e the ground or bellowing. Dr. Stratton attributes any excitement of cattle when one of the herd is bleeding to the cries of pain and the conduct of the wounded animal. A year or so ago he demonstrated by a similar series of experiments that red has no particular exciting effect upon bulls.

A RAILWAY in India recently made tests of a new type of concrete railway tie, constructed of two concrete blocks joined by a tie bar, rails being attached to specially treated wood plugs set in the concrete.

THE first state-owned public forest in the yellow-pine belt of the South was recently acquired by Louisiana through the purchase of a two thousand acre tract of timberland.

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SCIENCE NEWS

THE INTERIOR OF THE EARTH

Science Service

THE earth is built somewhat on the same principle as an old-fashioned metal-cored golf ball around which are wrapped several layers of lighter material ending in a thin surface crust. The metal core is pure iron or an alloy of that metal with nickel, according to a report to the Washington Academy of Sciences of Drs. E. D. Williamson and L. H. Adams, of the Carnegie Institution of Washington.

Discussing this report with a Science Service reporter, Dr. Adams said it was possible that the inmost core of the earth might be gold, or platinum, or other metals heavier than iron, but that it was practically certain that the center of the earth was an irregular sphere of iron about 4,200 miles in diameter. From the outer edge of this core, which is not sharply defined, to the surface is about 1,800 miles, and this distance is divided into three layers.

Next to the central iron core, Drs. Williamson and Adams relate, is a sort of mixed layer of iron and of rock, which extends with a gradually diminishing proportion of iron to within about 900 miles of the surface. Above this is a layer of rock, resembling that found at the surface but containing more magnesia and less silicates. Finally, there is the surface crust, about 35 miles thick, consisting essentially of the granitic rocks.

All this insight into the earth's anatomy is afforded through a study of the velocity of earthquake waves through the earth, mathematical considerations having to do with the mass of the earth as a whole, and a study of meteorites, whose average composition is believed to closely resemble that of the earth as a whole. For example, it is known that the density of the whole earth is about 5.52 times that of water, while the average density of the surface rocks is only 2.7. There must therefore be something heavier inside.

Pressure has something to do with that, as by squeezing the material of the rocks closer together it would make them denser, but the authors of the report state this would not be enough to cause such a great increase of density as is needed to explain the average density of the earth. The pressure at the center of the earth is calculated to be about 25,000 tons to the square inch.

A PORTABLE SEISMOMETER

Science Service

THE invention of a portable seismometer or earthquake measuring instrument, cheap, accurate and easily set up, was announced by Dr. Arthur L. Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington, in a lecture before the institution on November 27. The new instrument will be used in a study to be made of earth movements in California. A specimen instrument exhibited at the lecture recorded the vibrations due to the movement of heavy trucks on the street outside.

The advance over the older type of seismometer made through the invention of this new type may be measured from the facts that the old type costs several thousand dollars, weighs tons and occupies a large amount of space, while the new instrument costs about $25 and may be quickly taken down and packed in an ordinary suitcase.

The principle of the new invention is the twisting effect of earth movements upon a piece of fine vertical wire to the middle of which is attached by one side a small weight. The ends of the wire are fastened to a framework which in turn rests upon a solid pier of masonry or other structure fastened securely to the earth's surface. Earthquakes move this framework while the attached weight remains still. This results in a twisting of the wire which is measured by the reflection of a beam of light from an attached mirror. A continuous record is possible by directing the beam of light upon a roll of photo-sensitive paper revolved by clockwork.

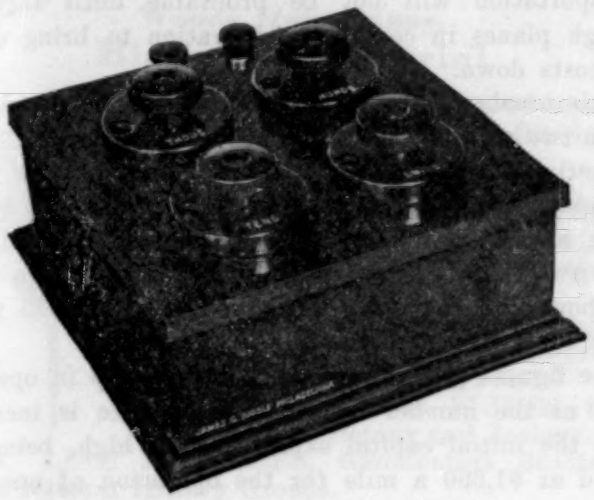
The apparatus itself seems extremely delicate to measure such a crude force as an earthquake. The wire is similar to the ordinary electric light wire filament and is about seven and a half inches long. The attached weight is a piece of copper about four fifths of an inch long and one tenth as thick, the mirror is about one sixth by one tenth of an inch.

Astonishing results have been obtained from the two of these little seismometers in use since last February in Pasadena, California. The Japanese earthquake was recorded in great detail from the beginning to the end. No little tremors in California go unrecorded. The device is sensitive to the passage of a street car at a distance of three quarters of a mile, while a railway train at a somewhat greater distance left a characteristic record.

Important practical applications are expected to follow the installation of numbers of these little instruments at different parts of California. It will easily be possible not only to record each quake, but to determine its direction and to track it to its lair. The machines may also be used for the recording of "artificial earthquakes" produced by the explosion in abandoned mines of left-over war explosives. Placed at varying and considerable distances from such explosions the record would be of great importance in determining little-known conditions in the deeper crust of the earth through which the waves would pass, conditions which might throw much light on the origin of quakes.

The instrument now in Pasadena accurately recorded a similar explosion 60 miles away last month when 115,000 pounds of blasting powder were set off at Palos Verdes.

Old fashioned seismometers or seismographs have been, because of their expense, rather a rarity in this country. With this new device it now becomes possible to set up a multitude of earthquake recording stations and to



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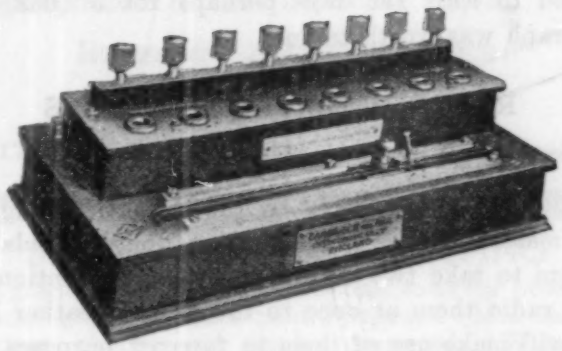

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broaden the knowledge of the earth's crust accordingly.

Incidentally, it becomes possible to take a moving picture of an earthquake wave. In experiments made at Pasadena, motion picture film was used to record the movements of the earth. While it was used no real earthquake occurred, but had one done so it would have been possible to have run the film through a projector and to have shown the sinuous vibrations on the screen. But it would be rather expensive and impractical to use film and to wait for days perhaps for a quake whose photograph was worth taking.

RADIO WEATHER REPORTS

Science Service

ORDERS have been issued by the U. S. Shipping Board to the masters of the 402 Shipping Board vessels directing them to take two regular weather observations daily and to radio them at once to the U. S. Weather Bureau which will make use of them in forecast purposes. They will also be furnished to foreign weather services.

The order is effective December 1, but applies only to vessels within certain specified areas. These are the Atlantic and Pacific oceans north of 10 degrees North Latitude, including the whole of the Gulf of Mexico and the greater part of the Caribbean Sea.

The messages will be sent to the nearest U. S. Navy Radio station when the vessel is within range of one. Ships near the European coasts will send their messages to Paris, whence they will be relayed to the United States. They will be taken daily at 7 A. M. and 7 P. M. Eastern Standard Time, which is one hour earlier than the observations are taken at the 200 North American stations of the U. S. and Canadian weather services.

The data which will be observed and sent in the coded message will consist of the height of the barometer and any unusual rise or fall, the temperature, the state of the weather, direction and force of the wind, the latitude and longitude; and following these a brief note in plain language whenever unusual weather is met or hurricanes appear to be forming.

Weather Bureau officials say that these messages will be of great assistance in forecasting for the continental areas of the United States and for Europe. More than that, it will be possible to give accurate forecasts for at least the main steamer tracks in the Atlantic, and, according to excellent authority, such a program will probably be undertaken by the United States Weather Bureau soon after the beginning of the year. These forecasts will not merely extend to the Grand Banks as forecasts do now, but will cover the entire track across the ocean and also on the southern routes as far as Bermuda and the Tropics.

COMMERCIAL AIRPLANES

Science Service

THE future of airplane transportation as an economic possibility depends chiefly upon an increase in traffic, resulting in lowered operating costs, says an exhaustive report to the American Society of Mechanical Engineers by Archibald and D. R. Black, airplane engineers. At the present time, they state, the field of the airplane is the carrying of mail and small packages. Passenger transportation will not be profitable until there are enough planes in continuous operation to bring operating costs down.

This number is set at 50 planes each way a day between two points as far apart as New York and Chicago. All estimates are made for night flying because this is necessary to compete with railroad service. The type of plane assumed was the ordinary biplane or monoplane with a 600 h. p. engine, and capable of carrying a load of about one ton at a maximum speed of 125 to 135 miles an hour.

The figures presented show a rapid drop in operating costs as the number of planes in service is increased, since the initial capital expenditure is high, being estimated at $1,690 a mile for the operation of one plane each way a day five days a week.

Increasing this headway to 50 planes each way daily would make possible the inauguration of a package service between New York and Chicago at a rate only slightly above the present express rates. Night letters might be carried distances up to 1,200 miles and delivered quicker than by telegraph, this service being possible at the present time. In fact, it is asserted that a package rate between New York and Chicago of $1.50 a pound would be possible with only a slight development of the business.

Commercial passenger traffic will have to wait until operations may be carried on with short headway, the report continues, giving the figure of 8.23 cents for the cost per passenger mile of fully loaded planes operating at the rate of 50 a day between New York and Chicago. This, the authors state, would be within competing distance of the extra-fare limited trains and the prediction is made that within 20 years at the utmost it will pay the railroads to undertake this service themselves in order to avoid competition from the air. Regular package service between New York and Chicago is predicted within the next two to five years.

MIGRATION OF STARLINGS

Science Service

THE English starlings of the northern states, after more than 30 years of residence, have finally learned to migrate. Huge flocks of these birds went south this fall, and will return with the coming of spring, as they did last year. They may truly be said to have been naturalized. Until recently, through sheer ignorance, they have had to adapt themselves to a climate wholly unnatural in its severity, for at home in northern Europe the species migrates regularly to southern Europe, and even to northern Africa, it is said.

Many of them have managed ordinarily to survive even the rigors of the New England winter, but only because they possessed much resourcefulness in snatching a living under most adverse circumstances. Many of them are still ignorant of the milder climate southward, in a land where food is plenty, and persist in making

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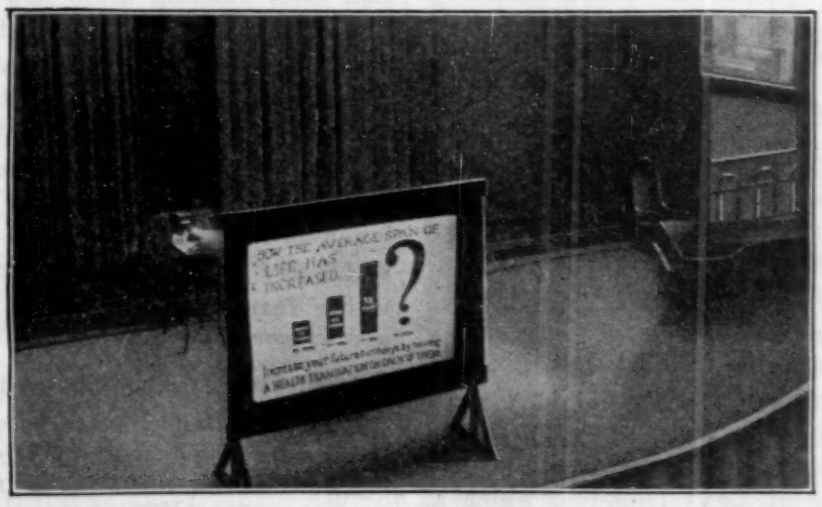

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their night winter quarters in the belfries of the steeples of cities and towns or more rarely in a country barn.

But doubtless these birds or their descendants will hear of the fairer land, and after a time the starling will be much less common in winter in the north. As it is, the winter population in the northern states is growing smaller and that of the middle Atlantic and southern states larger. The result should be a great increase in the starling population of America as a whole, for northern winters like that of last year kill off countless thousands of the birds.

The species may become the pest of which Europeans complain. Flocks grow to incredibly great size, even to hundreds of thousands, and when such a flock descends on orchard, vineyard or field, nothing remains for the owner. But on the other hand, there are records of insect blights, such as a plague of grasshoppers, being removed almost in a day by the coming of the starling hosts.

The starling has been a resident of the United States since about 1890, when half a hundred of them were released in Central Park, New York. They multiplied rapidly, and drifted into the surrounding country, and, as years passed, spread farther and farther in the country, until now they are common all through the east and the central states. Their first knowledge of migration, ornithologists believe, probably came from their contact with the flocks of blackbirds and bronze and purple grackles, with which latter species they are confused by many people, though they are easily distinguished by their yellow bills. They mingled with flocks of these and other species, and doubtless began to drift southward with them in the fall and back again in the spring.

THE EUROPEAN CORN BORER

Science Service

THE European corn borer, an undesirable immigrant which has already caused serious damage in a few widely separated parts of the east, has invaded New York City. This typical farm pest has apparently felt the lure of the bright lights and has established himself in that city, along the waterfront sections of Brooklyn.

Fearing that he may naturally feel like returning to the farm in the springtime and that he might invade some of the rich truck farming section of the Long Island suburbs, the U. S. Department of Agriculture is on his trail, and the second battle of Long Island in which a foreign invader is the enemy is about to begin. He will literally be fought with fire.

This latest invasion is believed to have been due to broom-corn. Last year the crop was short and much was imported from Europe where the corn borer is a serious pest. The imported corn was sterilized by steam, and no borers are believed to have got in through regular channels; but some bundles were broken in transit and were thrown overboard in the harbor, unsterilized. These are believed to have drifted ashore and started the infection.

The borer first arrived in this country a decade ago and has spread chiefly around Boston, in the upper Hudson valley, and along the shores of Lake Erie. In badly affected fields it may cause a loss of 15 per cent. of the crop. Other crops besides corn are affected.

While making his home in New York, the borer is dwelling in hollow-stemmed weeds which are quite favored by him. In these he passes the dormant larval stage during the winter, and upon this habit the warfare against him depends. The Department of Agriculture men will first mow and then burn all the weeds in the infected area, which is largely vacant lots.

The importance of the fight may be recognized even by those who think a farm pest in a great city nothing to worry about, when it is known that a few miles eastward out on Long Island one million bushels of sweet corn are raised every year.

ITEMS

Science Service

NAVIGATION lights on airplanes as well as beacon and boundary lights at landing fields were recommended by Lieutenants H. R. Harris and D. L. Brunner, of the U. S. Air Service, in a recent address before the American Society of Mechanical Engineers. In addition to these, parachute flares and hand flashlights or similar devices for signaling purposes were advised. The beacons at terminal landing fields should have a candle-power of at least 250,000, they stated, and illuminated wind cones should be provided at every landing field. With these aids, night flying could be carried on with safety and reliability.

INTEREST in projected super-power development in the northeastern states, with high tension electric transmission lines running from immense power plants at the coal mines to the great industrial centers, has overshadowed the real progress toward super-power development which has been made in other parts of the country. There are now only four gaps with a total extent of twenty-five miles in a continuous electric power system along the Pacific Coast from British Columbia to Mexico, a distance of 1,400 miles. Five of the southeastern states are included in another super-power development which furnishes hundreds of thousands of horsepower, and extensions are projected into neighboring states.

INSUFFICIENT sleep causes impairment of memory, according to recent researches on the subject of sleep by Professors Engelen, Frerichs and Weygandt. The memory becomes unreliable even if the shortage of sleep has occurred for only a short time. Eight hours is the average needed for sleep, but brain workers sometimes require more. A reduced period of slumber may be partly made up for by increased intensity, a short period of deep, undisturbed sleep having the same effect as a longer and lighter one. The investigators also conclude that brain workers need a month of rest every year and that even longer vacations do not cause a lessening of acquired abilities but rather an intensification of them.

THE finding of potash deposits in Czechoslovakia, which are estimated to contain at least 70 million tons, has been reported to *Industrial and Engineering Chemistry*, the publication of the American Chemical Society.

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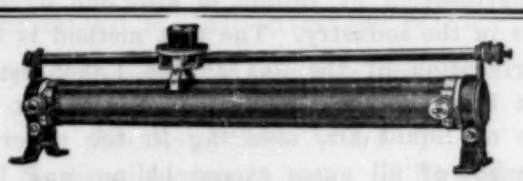

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SCIENCE NEWS

COMMERCIALIZED ELECTRONS

Science Service

THE atoms of which all matter is composed were described as sort of half-tamed solar systems by Dr. Paul D. Foote, head of the department of atomic physics at the U. S. Bureau of Standards, in an address before the American Institute of Chemical Engineers at Washington on December 6. These "solar systems" are capable of a certain amount of control by man, and upon this control depends all progress in chemistry and not only that but all progress in all applications of science to the use of man.

The electrons which compose the "planets" of these atomic systems have literally been commercialized, and whole industries are absolutely dependent on the understanding of the caprices of these minute particles which are really electricity. An electron thrown out of a glowing vacuum tube filament makes telephonic communication across the sea possible, another electron may produce the light of the arc lamp; under other conditions they are responsible for all the reactions which are the basis of the chemical industry.

These atomic "solar systems" consisting of a definite number of infinitesimal electrons whirling about a central nucleus, while in some ways resembling our well-known family of planets, are in other ways very different from it. For example, said Dr. Foote, if a comet or stray body big enough to have any effect were to collide with a real planet, the whole energy of our solar system would be permanently altered. But if a "comet" in the shape of some form of radiant energy collides with the electron of an atom revolving about its nucleus something quite different occurs. The energy of the system is increased, but only by a certain perfectly definite amount, and if there is any energy left over the "comet" takes it along with it on its journey. Real solar systems differ in energy; no two are alike; but all the atoms of the same kind of element are systems of identical energy and structure, and each behaves exactly like all its fellows.

The "solar system" theory of the atom now being expounded in this country by Professor Nils Bohr is not so satisfactory to the chemist as a static theory which provides fixed points for hooking up atoms to make molecules. But Dr. Foote thinks that the dynamic and static theories are not really in conflict.

The outer orbits of electrons might be regarded, for instance, as the corners of a cube, and this simple static picture of an atom is sufficient to explain many known facts.

Atoms after all, he concluded, are more complicated than either a cube or a sphere, and newer facts require newer theories. These Bohr has attempted to provide by the use of data provided by the spectroscope. The Bohr theory while a distinct advance will, in Dr. Foote's opinion, either be eventually superseded by a better one, or will be so modified that it will lose its identity. Its present success is due to the vast number of observed facts which it has been able to correlate by means of a very few and simply stated ideas.

HELIUM GAS AND AIRSHIPS

Science Service

THERE is enough helium gas now available in the United States to keep filled and ready for service 200 airships of the size of the navy dirigible *Shenandoah*, according to Dr. Richard B. Moore, former chief chemist of the U. S. Bureau of Mines. These ships can be kept in the air for five years.

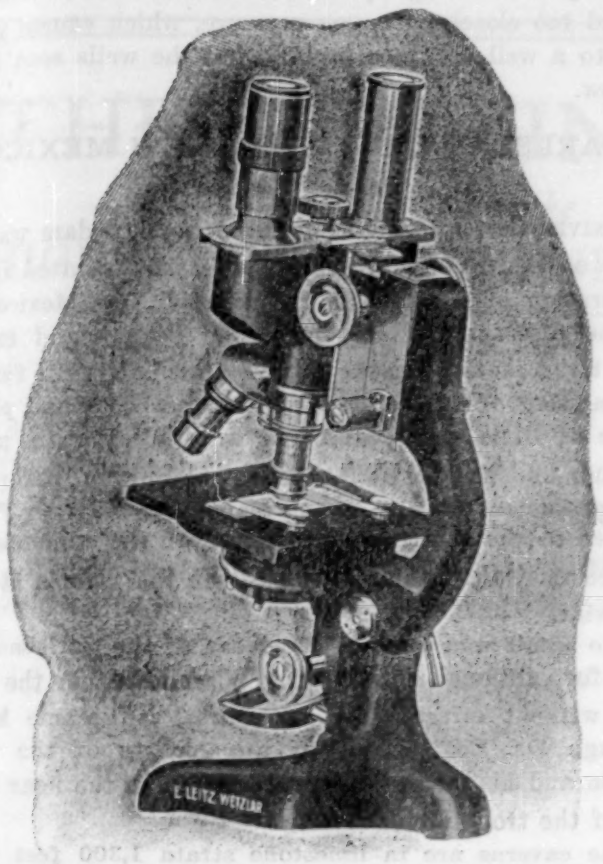
According to Dr. S. C. Lind, successor to Dr. Moore as chief chemist of the Bureau of Mines, laws for the conservation of the helium resources of the country will be introduced at this session of Congress. The gas occurs principally as a constituent in the natural gas wells of Texas, and the problem is to separate it from the inflammable part of the natural gas which may then be used for industrial purposes. There is a great demand for the unseparated natural gas, from which the helium is absolutely lost unless special measures for recovery are taken.

Helium inflated airships are useless for very long flights unless some method for condensing the water vapor, which is one of the products of combustion of gasoline, is employed. Such a method has been devised. It prevents the ship from getting lighter and lighter, and so having to release helium if it is desired to come to the surface. Rather than lose the valuable gas, the *Shenandoah* on her recent trip to St. Louis dived near to the ground and was then pulled to earth by a force of some 300 men, a method which is not always applicable. Dr. Lind said that if 90 per cent. of the water vapor could be recovered there would be no loss of weight of the ship.

The purification of helium is also one of the great problems in the industry. The best method is that used in repurification of the gas at the Lakehurst station, where it is passed over activated charcoal at the temperature of liquid air, resulting in the adsorption by the charcoal of all gases except helium and hydrogen. This results in nearly 100 per cent. helium. Airships are now using a mixture of 90 per cent. helium and 10 per cent. nitrogen.

Other important sources of helium gas besides the gas wells of the Dallas-Fort Worth district are known to the government, but their location and extent are being kept military secrets. When the industry is more developed and the needs of the army and navy are fully met, the surplus supply of the gas will be released for commercial purposes. At present the military uses absorb the entire output.

Dr. Moore, during further discussion, emphasized the unique military value of helium, saying that this country contains all the known world supply and that as an asset in time of war such a resource is invaluable and should be carefully conserved.



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THE SPACING OF OIL WELLS

UNUSUALLY close spacing of oil wells, or what is known as "town lot drilling," has been responsible for great wastes of oil and for large monetary losses to investors in the development of many petroleum fields in the United States is reported by the Department of the Interior, following a study of the subject by engineers of the Bureau of Mines.

Town-lot drilling has recently become a factor in the development of the new fields of southern California. Wells are being drilled in the Santa Fé Springs field on adjacent town lots, some of which are not more than 120 feet square. Because of the great depth and the high cost of these wells the cost of developing this field will be excessive, and many wells doubtless will not pay for themselves.

The Burkburnett town-site pool in Texas furnishes a typical example of losses and wastes from close drilling. Within six months after the first well was drilled, the average initial daily production per well had dropped from 2,000 barrels to 300 barrels; within a year the average initial production was only 38 barrels a day per well. In the town-site proper, the average spacing was less than one acre per well.

The spacing of wells is an economic problem which is governed by many factors. These include the profits that may be derived, the recoverable amount of oil or gas, the porosity, saturation and thickness of the producing sands, the extent and structure of the productive area, the gravity of the oil, gas pressure and depth. Theoretically, the closer the spacing the greater the ultimate recovery of oil from oil sand. However, the many factors opposed to close spacing far outweigh the possible benefits of greater recovery of oil wells and implies the influence of promotion schemes. Town-lot drilling usually is not practiced by bona fide operators except when necessary for the protection of their property. Unscrupulous promoters often sell parcels of land far too small to warrant the drilling of a well from an economic standpoint, causing adjacent operators to drill an unnecessarily large number of wells to protect their holdings against drainage. Speed in getting a well into the pay sand is a prime requisite because the first well in any locality benefits by obtaining the flush production. It often happens that a well will produce more oil during the first 10 days or two weeks than can afterwards be pumped in a year or more. Extreme speed in drilling is largely responsible for the waste that always accompanies town-lot drilling. In order to be the first to drill into the pay sand, careless and inexperienced operators often neglect to shut off water properly and to protect sands; hence wastes from infiltration of water, dissipation of gas, and the migration of oil and gas are often tremendous. Another waste occurs because of the unprofitable yield of many wells and the carelessness with which they are abandoned.

Although oil can be recovered more rapidly and in larger amounts with a greater number of wells if they are drilled before the gas pressure is reduced, too rapid exhaustion of oil and gas may cause the rapid approach of edge water. During its encroachment the edge water may "pocket" large quantities of oil. When wells are spaced too closely, the gas pressure, which causes oil to flow to a well, declines rapidly and the wells soon cease to flow.

CARLSBAD CAVERN IN NEW MEXICO

Science Service

A RIVER that appeared not to be worth a dam was the cause of the geological explorations that resulted in the exploration of the Carlsbad cavern in New Mexico and in the discovery of its surpassing beauty and extent. The river is the Pecos. Dams built along it for the impounding of water for irrigation purposes had proved to be of little use because the water disappears underground, and so the U. S. Geological Survey, before advising the construction of any more dams, sent Dr. Willis T. Lee to the scene at the request of the commissioner of reclamation to find the cause of the river's strange behavior.

The result was the real discovery of the Carlsbad cavern, for, although it is nearly 20 miles from the river and without effect upon its course, it became known through Dr. Lee's study of the geology of the whole region and his tracing of strata found in the near vicinity of the troublesome river.

The caverns are in limestone strata 1,300 feet thick, but above and below this layer are other layers of rock salt and gypsum. These were found to be the real trouble makers. The strata are tipped at an angle to the surface, near the river and under it. The gypsum and salt are soluble in water, and when the dams were built and the water-level rose beyond a certain point, it dissolved its way through these strata underground and out on to the surface again some miles below the dam.

Tracing the strata back to the foothills of the Guadeloupe Mountains, about 22 miles southwest of Carlsbad, Dr. Lee rediscovered for the world the great cavern, now made by Presidential proclamation of October 25 a National Monument.

The caverns were first discovered in 1901. Vast numbers of bats were observed issuing from a hole in the side of a hill and exploration revealed a cavern of unknown extent. It remained practically unexplored and unnoticed until this year when Robert A. Holley, of the General Land Office, surveyed about three and a half miles of it. Dr. Lee later examined it from the geologic and scenic points of view.

It is, according to Dr. Lee, one of the greatest if not the greatest cavern in the world. Its total length is quite unknown. It extends at least 1,000 feet downwards from the entrance. The formations of stalactites and stalagmites are of extraordinary beauty. One of the "rooms" in the cavern is half a mile long, several hundred feet wide and with a ceiling so high that torches failed to disclose it, their bright beams being lost in the impenetrable gloom.

More remarkable discoveries are likely to be the result of further exploration since the geologic formations are most unusual. Underneath the limestone layer in which the cave was discovered are beds of gypsum and rock salt of great thickness. These materials are soluble in

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(cf.—Osborne & Harris, Jr. Am. Chem. Soc., 25-IV. 346)

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water which seeps through and honeycombs them. Dr. Lee believes that in these beds may be sculptured other great caves whose extent and beauty can only be guessed at for the present.

Incidentally, such caverns in salt beds might be developed into mines of incalculable extent and richness. The discovery is considered the most important in the geological field in recent years.

PASTURE LANDS

Science Service

OUTLINES of a plan for the study and improvement of the pasture lands of the United States have been prepared by the advisory committee of the American Society of Agronomy for the National Research Council. The purpose of the proposed investigations is in general to find practicable means for the conservation and improvement of the pastures which feed more than half of the cattle and other farm animals in the country.

The committee states that two thirds of the cultivated area in crops in the United States is devoted to the production of feed for live stock, the proportion varying in different sections from 91 per cent. in New England to 51 per cent. in the west south central states. From other studies it appears, the committee says, that since all the forage consumed in one year would feed about 50,000,000 adult cattle or their equivalent, and since there are more than twice that number in the country, it follows that over one half of their feed was furnished by pasturage. It is estimated that pasturage costs only about one fourth as much as harvested forage.

According to the committee, "the neglect of tame pastures and the abuse of natural wild pastures is a disgrace to American agriculture. Only the fact that grass will stand an almost incredible amount of abuse has prevented its utter destruction. Relegated to land too rough to till, neglected by the farmer, abused by the grazer, ignored by the investigator, the permanent pastures still furnish at least one third of the feed consumed by domestic animals. 'Better pastures' should become the slogan of American agricultural progress."

The outlined investigation provides for the preparation of maps of the grasslands, both natural and artificial; studies of pasture plants, soils and the effects of grazing; production of meat, wool, etc., to the unit area; period and rate of grazing; fertilizers; troublesome and poisonous plants; animal and insect pests; and economic and social problems. The proposed investigations would be carried out on farms of from 150 to 300 acres, located in the principal grazing areas of the country.

In view of the enormous importance of pastures, there is need for liberal appropriations to conduct the necessary investigations. Pasture investigations have heretofore been much neglected due to lack of funds to do the work.

ITEMS

Science Service

OIL fuel vaporization in Diesel engines is neither necessary nor desirable according to a report by the Diesel Motor section of the German Engineers' Society, which states that the previously accepted belief that gasification first had to take place must be given up. The same report states that piston pressure can not be increased merely by increasing the fuel, but if air is condensed and then added the efficiency may be increased 30 to 40 per cent. Further efficiency is predicted as the result of the use of exhaust gases for compression of the intake air as is done in airplane engines. Mist explosions of liquid fuel in droplet form require more oxygen than if the fuel is vaporized.

A WIRELESS station using mountain peaks for antennae masts has recently been put into service in upper Bavaria. The wires are supported by a strong cable and extend from one peak 5,100 feet high a distance of about a mile and a half across country to the top of a smaller hill of some 2,820 feet elevation. The station is designed to communicate directly with the Far East. Special arrangements were necessary for the fixing of the cable ends and to allow for its stretching. The end of the cable is fastened to a small carriage weighted with stones and running on rails. When the cable is bent by snow or wind the carriage is pulled forward. When the stress ceases, it rolls backward on its sloping railroad.

Two German scientific men, Professor Kleine and Dr. Fischer, have been sent to Africa by the government of the Belgian Congo to study the curvative effect of the new drug, "Bayer 205," upon animals suffering from African sleeping sickness. The effect of it upon animals is not known, but many cures have been reported among the 170 human patients treated in Rhodesia and the Congo. Although it is difficult to keep the native patients under continuous supervision, only a few died and in most cases the blood was found to have been freed from the deadly parasites. The disease, which is entirely different from the so-called "sleeping sickness," prevalent in Europe and America, is due to the bite of an insect, the tsetse-fly.

VAGRANT and injurious X-rays may be confined to the room in which they originate by the use of barium in plaster or paint, Maximilian Toch, a chemist of New York City, reported at the recent meeting of the American Institute of Chemical Engineers. Long exposure to X-rays which have escaped from doctors' offices through walls, floors or ceiling have been reported to have caused serious injury to persons in adjoining rooms, Mr. Toch said. To prevent this, lead which is impervious to the rays has been used in metallic form as a sheathing of X-ray rooms; but the metal is heavy and buildings with rooms so equipped require strengthening. This is not necessary if some compound of barium be used instead of lead, Mr. Toch said, since barium compounds are opaque to X-rays. His method has been either to mix the barium with the wall plaster or to use barium compounds in the wall paint. Either method keeps the rays where they belong.

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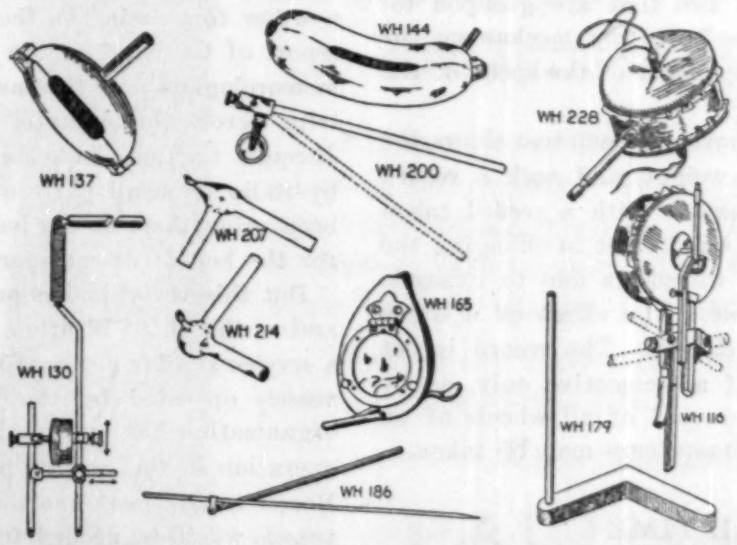

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SCIENCE NEWS

TESTS OF LOCOMOTIVES

Science Service

RAILROAD officials, representing a majority of the leading railroads of the country who went to Erie, Pa., to witness a demonstration of new types of electric locomotives and were thrilled to see one of the powerful Mikado type steam locomotives pulled backwards in a spectacular tug-of-war by an electric giant, and to see another type of electric locomotive glide over the rails at 105 miles an hour, found great interest in another device known as the otheograph, which accurately measures the stress or action on the rails of each separate wheel of a locomotive or motor car.

This new instrument, as explained by A. F. Batchelder, designing railway engineer of the General Electric Company, shows by a graphic chart the extent and characteristic of both the vertical and sideways thrust of all the wheels on each rail. The vertical weight is carried by heavy springs underneath the rail and the sideways thrust is carried through similar springs set vertically and bearing against the head of the rail. The deflection of these springs on the passage of the locomotive is recorded through a lever having an 8 to 1 ratio, with a pointer at the end which traces a record on paper wrapped around a rotating cylinder.

The otheograph ties may be installed in place of the regular ties, either singly or several grouped together, and on curves or straight tracks. The present installation at Erie comprises 25 of these ties grouped together covering a distance of fifty feet of straight track. The revolving mechanism provides for moving all of the recording cylinders on each side of the track simultaneously so that as many records may be taken of each side of the locomotive as the number of ties that are grouped together. The movement of the operating mechanism for the recording cylinders is independent of the speed of the locomotive.

The record from a slowly moving locomotive shows the equalized distribution of the weight, and such a record serves as the basis for comparison with a record taken at high speed. The effect of side thrust in changing the vertical component, and any variations due to dynamic unbalance, are quite noticeable. The effect of a wheel with a flat spot shows very clearly. The record is not necessarily limited to that of a locomotive only, as by moving the paper slowly the record of all wheels of an entire train of a hundred or more cars may be taken.

NAUTICAL TIME

Science Service

BY agreement of the United States, England and France, the U. S. Nautical Almanac and the corresponding publications in the other countries are going to suffer a revolutionary change in the interest of safety at sea, beginning with the issue for 1925, now about to be issued.

The change is in the method of expressing time. It is now given in astronomical time, the day beginning and ending at noon. In the almanac of 1925 it will be given in civil time, the day beginning and ending at midnight. In each case the time is that of Greenwich Observatory, the time standard for all astronomical observations. Hours will be counted from 0 to 24 as in the present almanac.

The change will do away with an endless amount of confusion and danger, navigators say. The astronomical day begins 12 hours later than the civil day of the same date; that is, January 1, astronomical time, begins at noon of January 1, civil time. This difference frequently causes confusion, navigators neglecting to note the change or figuring it as just the opposite. Errors from this cause might amount to as much as 10 or 20 miles in working out the position of a vessel at sea. This danger will be ended by the new system, which has been recommended by navigators for years and which will finally be put into effect.

Incidentally, the change will require a new edition of that handbook of every navigator, Bowditch's American Practical Navigator. All the problems in the book are worked out according to the old system, and there is a lengthy section instructing the novice how to convert civil into astronomical time. This will all have to be changed, the burden of the work falling on the U. S. Hydrographic Office.

FORECASTING AT SEA

Science Service

FRANCE is leading the United States and the world in weather forecasting on the sea. According to the annual report of the chief of the U. S. Weather Bureau, French meteorologists and forecasters have been making regular trips across the Atlantic on their naval training vessel Jacques Cartier, have been collecting weather reports by radio from all parts of the North Atlantic and have been using them as the basis for forecasts sent out daily for the benefit of mariners.

But this vessel makes only about three voyages a year, and so the U. S. Weather Bureau has prepared plans for a service similar but continuous which may be given from vessels operated by the U. S. Shipping Board. That organization has approved the plans and has offered cooperation in the way of providing facilities on Shipping Board vessels on the northern transatlantic routes. Three vessels would be needed for continuous service. The need for such a service was demonstrated last winter, since storms on the Atlantic were unusually frequent. Its value would be, "to keep vessel masters informed at all times as to weather conditions which might cause damage or retard progress; enable them to avoid such storms as far as possible; to lay out ship work *en voyage* and

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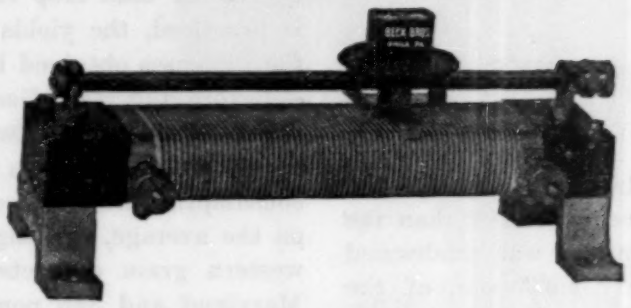

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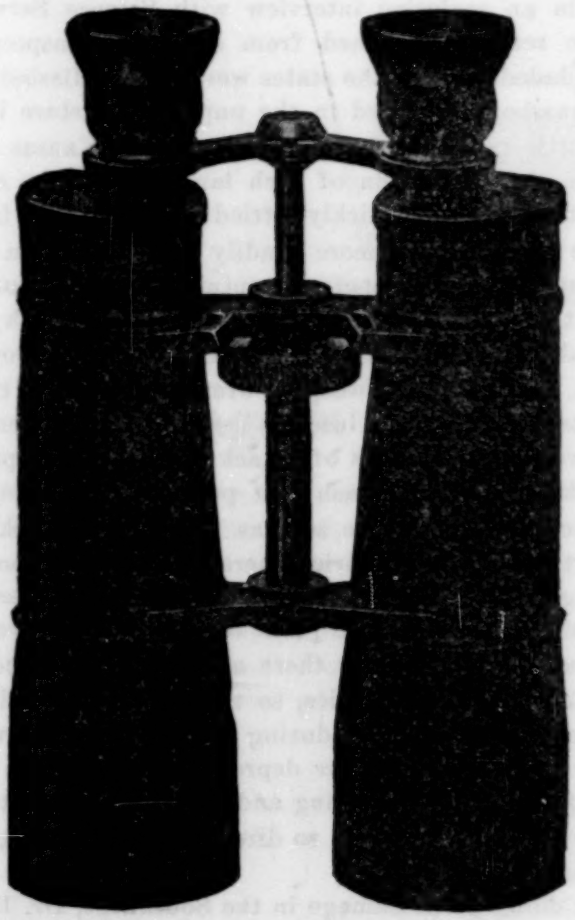

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SYNTHETIC SOFT DRINKS

Science Service

THE use of synthetic foods or drinks containing pure acids such as the acetic acid of vinegar, rather than the acids made in Nature's own laboratory, was condemned on scientific grounds by Dr. Henry Leffmann, of the Philadelphia College of Pharmacy and Science, in an address before the Franklin Institute on December 13. It has been found that in natural fluids such as milk, blood, fruit juices and fermented liquids, there are substances which modify the irritating effect of the acid and cause what is known as the ''buffer effect.'' So-called stainless steel is not affected by malt vinegar, but is corroded by a solution of acetic acid of equal strength, although the acid is the same in both cases.

The determining condition in the effect of acid solutions on living things is not merely the chemical acidity, but what is known as the ''hydrogen ion concentration,'' a term rapidly coming into use, Dr. Leffmann said. This merely means the relative number of electrified hydrogen atoms or ''ions'' in the solution. All acids contain ''hydrogen ions'' which are the cause of its greatest ac- split off in an electrified form from the rest of the molecule of the acid.

The lecturer contrasted ordinary vinegar of four per cent. acidity, with nitric acid of the same acidity. The former may be eaten without ill effect, the latter is corrosive. The reason for the difference in behavior is that the nitric acid solution has a greater proportion of ''hydrogen ions'' which are the cause of its greater activity. ''Modern investigation has shown,'' said Dr. Leffmann, ''that in the case of the nitric acid a large amount of it has been changed by the water with which it is mixed in such a manner that its hydrogen (to which its acidity is largely due) has been in great part given an electric charge which has made it very active, while in the case of the acetic acid only a very small portion of the hydrogen has been so electrified.''

The concentration of hydrogen ions in the water in the soil, upon which plants depend for growth, has been found to have a most important effect upon such growth. Rhododendrons were cited by Dr. Leffmann as a plant which requires a high concentration of hydrogen ions in order to thrive, and some diseases of the potato may apparently be controlled by growing it in a soil where the concentration is high enough to kill the disease but not to injure the plant.

CROP ROTATION

Science Service

CROP yields may be increased about as much by the practice of crop rotation without fertilizers as by the use of fertilizers without crop rotation, Dr. Milton Whitney, chief of the Bureau of Soils of the U. S. Department of Agriculture, told the American Institute of Chemical Engineers in session in Washington on December 7. If both crop rotation and the use of fertilizers is practiced, the yields are nearly equal to the sum of the increases obtained by rotation and by fertilizing.

Before the war, Germany was the greatest user of commercial fertilizer, with a consumption of 188 pounds to the acre of land in crops, Dr. Whitney stated. The consumption in this country was 40 pounds to the acre on the average, ranging from practically nothing in the western grain districts to 150 pounds to the acre in Maryland and 345 pounds in Florida. At present the cotton crop west of Alabama is practically unfertilized and the commercial crops of grain and hay are produced without artificial fertilization.

Dr. Whitney said the abandonment of the medieval system of agriculture in England, the development of individual farm holdings, the introduction of crop rotation, fertilization, and better methods of tillage, had increased the average yield of wheat in that country from 6 to 32 bushels to the acre in about 700 years.

ERADICATION OF GRASSHOPPERS

Science Service

MAN-POWER, money and arsenic are the best weapons in the fight of northwestern farmers against the grasshopper pest which caused millions of dollars damage to grain crops last summer, said Dr. George A. Dean, of the Bureau of Entomology, U. S. Department of Agriculture, in an exclusive interview with Science Service. Dr. Dean recently returned from a tour of inspection which included most of the states west of the Mississippi.

The grasshoppers breed in the unplowed pasture land of the cattle ranges, he said. Where, as in Kansas and Nebraska, the proportion of such land is small as compared with that of the thickly settled and well tilled farm land, the pest may be more readily controlled. In the Northwest the grasshoppers so outnumber their human enemies that they can eat up all the poison which the few inhabitants of a large area can afford to provide for them, and then can sweep on over the bodies of their ''shock troops'' into the luscious crops awaiting them.

The two direct methods of attack on the grasshoppers are by the use of branmash bait poisoned with arsenic, and the cultivation of the soil, as plowing and disking, disturbs their egg pods buried there to await the coming of spring. In Kansas, cooperation has made possible the practical control of the pests for the past five years. In Montana and Wyoming there are too many breeding grounds and too few enemies, so the grasshoppers flourish. Weather conditions during several seasons were ideal for them and for their depredations, since the dry weather favored their breeding and dried up their natural food, the pasture grass, and so directed their attack upon the farmers' crops.

A pest doing great damage in the Southwest, Dr. Dean found to be the alfalfa-seed chalcis fly which lays its eggs in the immature seed of the plant. As much of the

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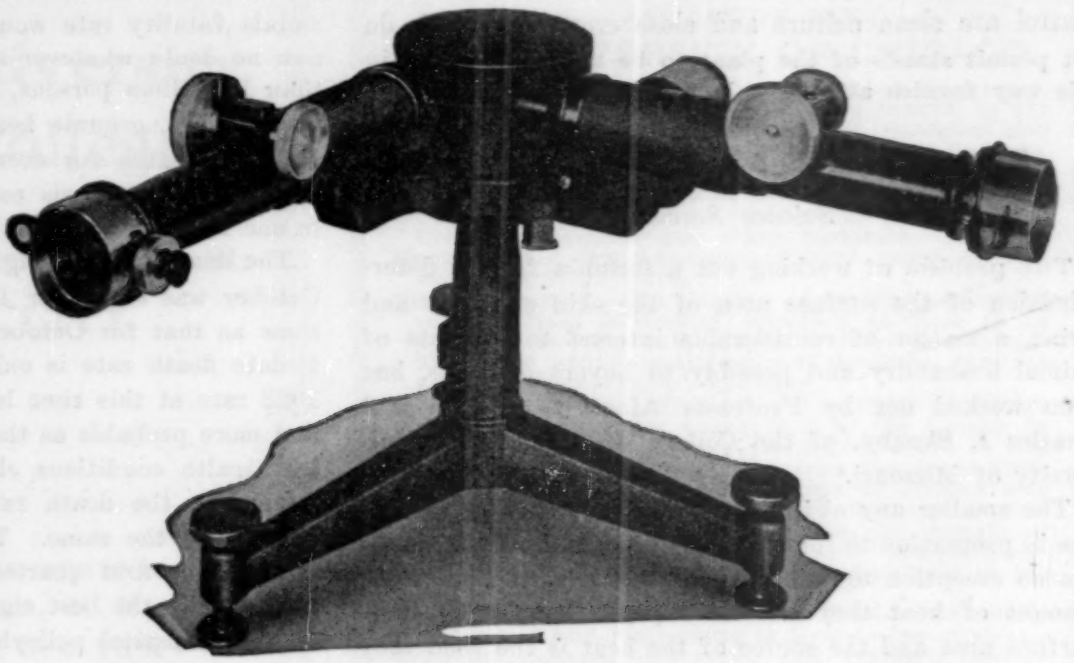

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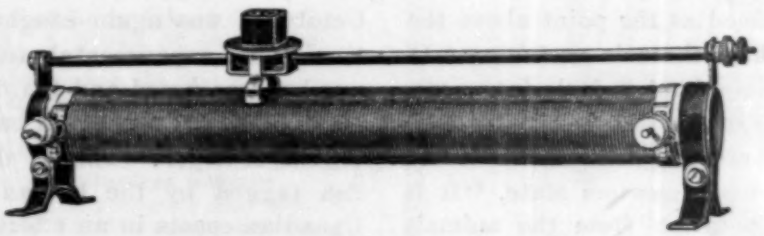

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southwestern crop of alfalfa is raised for seed, this creature is an enemy to be feared. The best methods of control are clean culture and close cropping, which do not permit stands of the plant to be abandoned, and in this way furnish attractive homes for the pest.

THE SURFACE AREA OF ANIMALS

Science Service

THE problem of working out a formula for the determination of the surface area of the skin of cattle and swine, a matter of considerable interest to students of animal husbandry and possibly to buyers of hides, has been worked out by Professor Albert G. Hogan and Charles I. Skouby, of the College of Agriculture, University of Missouri.

The smaller any object is, the greater surface area it has in proportion to its weight. Cattle and other animals are no exception to this general principle, and since the amount of heat they radiate depends largely on their surface area and the source of the heat is the food they eat, the knowledge of just what is the extent of surface is of importance to students of how much food is needed to keep the animal machine in good working order.

By application of this new formula, all that is needed to know is the length of the body of the animal, its weight, and a certain number called a constant which enters into the equation and is the same for every species. With these the area of the beast may be figured out. Results are accurate to less than five and a half per cent.

The length of the body of the animal is measured from the point of the withers to the root of the tail. The "point of the withers" is defined as the point above the junction of the second and third thoracic vertebrae. If any portion of the neck of the animal is included, measurements are likely to be inaccurate and no reliable formula can be worked out, since a change of position would affect the result and, as the experimenters state, "it is impossible to secure any cooperation from the animals in taking these measurements."

AUTOMOBILE ACCIDENTS AND TUBERCULOSIS

Science Service

ONE person died from an automobile accident during October to five who died from all forms of tuberculosis, according to a report just issued by Dr. Louis I. Dublin, statistician of the Metropolitan Life Insurance Company, on the mortality during that month among the 14,500,000 industrial policyholders of that company. Auto fatalities were at the record-breaking figure of 19.4 per 100,000, never equalled in any previous month. Fatal accidents of all sorts showed an increase of 25 per cent. over the corresponding month of last year. Commenting on these figures, Dr. Dublin said:

"The almost constant comments made on the high automobile fatality rate by those concerned with the health and safety of the American people may seem like ceaseless repetition. However, they merely fulfill the obligation to keep emphasizing this deplorable condition until we are successful in turning the tide. In August we stated that little doubt remained that the 1923 automobile fatality rate would be higher than ever before; now no doubt whatever remains. In this group of more than 14 million persons, the leading cause of death during October, organic heart disease, was responsible for only six deaths for every automobile fatality; and all forms of tuberculosis combined caused only five deaths to one from an automobile accident."

The death rate among the industrial policyholders for October was eight per 1,000, which is substantially the same as that for October of last year. The 1923 year-to-date death rate is only a very little higher than the 1922 rate at this time last year. It thus becomes more and more probable as the year draws to a close that unless health conditions change sharply for the worse in December, the death rates for 1923 and 1922 will be practically the same. The year opened with the most unfavorable first quarter since 1920, but this has been followed by the best eight months in the health history of the industrial policyholders.

ITEMS

Science Service

CODFISH No. 231 has been caught three times by the same fishermen at least twenty miles from land on a fishing ground many square miles in extent. This is a fish story vouched for by the scientific records of the U. S. Bureau of Fisheries. Experts on the government boat *Halcyon* caught this cod on Nantucket Shoals, Mass., on June 28, and promptly clamped a metal tag bearing the number 231 upon his tail. He was turned loose, but on October 3 was again caught by the *Halcyon* while continuing its experimental work in the same waters. The number was noted and the fish again released. On October 15, No. 231 was again back with his old acquaintances on the *Halcyon*. This is the record of one of the 128 fish tagged by the bureau off the New England and Canadian coasts in an effort to learn more of the migration routes and habits of valuable food fish. Since October 15 fish tagged off Massachusetts have been taken off the New Jersey coast, and the records indicate that they are migrating toward the south. It is expected that a comparatively large number of fish tagged this summer will be caught in the vicinity of New Jersey during the coming winter and spring.

DR. P. S. HENCH and Miss Martha Aldrich, of the Mayo Clinic, report to the American Medical Association a method of examining the saliva which yields valuable information regarding the function of the kidneys. After the saliva is collected the amount of urea that it contains is determined by a chemical test using sodium carbonate and mercuric chloride. Tests on more than five hundred persons showed that the salivary urea definitely paralleled that of the blood. Urea is a waste product formed in the body by the chemical processes of living. It is carried by the blood to the kidneys and the amount of it present in the blood is a measure of the efficiency of those organs. The new method of testing saliva may make blood tests for this purpose unnecessary.

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SCIENCE NEWS

MIRA, THE STRANGE STAR

Science Service

THE recent discovery of a very faint companion to the well-known variable star, Omicron Ceti, called Mira or the "Strange Star," is baffling astronomers and may necessitate a revision of present theories of the size and distribution of the stars.

In 1596 the Dutch clergyman, David Fabricius, noticed a strange star in the constellation the Whale, which he had never seen before. Later observations showed that the star was not constant but varied in light and was only visible for a short time every year. For this reason the star was given the name Mira, the "Strange Star." After more than three hundred years of observations astronomers thought that they had come a little closer to the solution of the mystery of this star.

It was found that the star varies from the second magnitude at maximum to the ninth magnitude at minimum when it is sixteen times too faint to be visible to the naked eye. The time in which these light changes take place has been determined to be a period of eleven months, or exactly 330 days. Examined in the spectroscope the star shows a spectrum which the astronomers at the Harvard Observatory call of class M which means that it is a red star. In contrast to the majority of red stars which are not variable, however, Mira shows bright lines due to hydrogen in its spectrum.

That is in short all the knowledge we had about this peculiar star until a few years ago. It was discovered at Mt. Wilson by Dr. A. H. Joy that when the star was at its feeblest the spectrum had a certain peculiar aspect which up to that time had only been ascribed to blue stars. It was therefore concluded that a blue star might be very close to the red star, but a search for this blue companion with the great telescope of the Yerkes Observatory yielded no results.

Repeating the spectrum tests, the blue star still seemed to be there and again the star was examined for duplicity, this time by Professor R. G. Aitken of the Lick Observatory. In the clear sky of California he succeeded in seeing a tiny little star close to the variable. The angular distance as measured in the telescope was only a second of arc, or equal to the angle spanned by an inch at a distance of three and a half miles. The little star was about half a magnitude or one and one half times fainter than the variable which at that time was of the ninth magnitude.

This discovery has baffled astronomers a good deal. They must choose between two alternatives: That the blue star and the variable are physically connected, or that they simply by mere chance seem to be together in the sky and may really be at entirely different distances from us. In the first case, since we know the distance of the larger variable approximately, we can tell that the blue star is in reality ten times fainter than the sun or ten thousand times fainter than any other blue star of that type. If, on the other hand, the stars are not physically connected and the blue star is of ordinary brightness, it must be 8,000 light years off and that lands it in a region of space where we know no other star of this kind. Observations in the near future will enable us to decide which of the two is the right conclusion, for the variable star itself has a motion in the sky which will decrease the distance between the two stars seven tenths of its value in three years.

When that time comes it may be found necessary to form a new and third hypothesis to account for its existence and peculiar behavior.

ELECTRICAL TREATMENT OF FIELDS

Science Service

YIELDS of grain have been doubled in some cases through the application of electricity to fields during experiments made by Professor Vernon H. Blackman for the electro-culture committee of the British Ministry of Agriculture and Fisheries.

The electrical discharge was from overhead wires, but was not applied during the whole growing season. Experiments so far completed demonstrate the extreme complexity of the whole problem, however, and further work is planned.

Earlier experiments in the field seemed to hold out little hope that electro-culture would ever become a commercial proposition. In these the discharge varied in the different trials from two to twelve ten-thousandths of an ampere per acre and the voltage varied from 25,000 to 56,000. The discharge was applied for from 6 to 8 hours daily from April to August. The cost of course was quite prohibitive, and the increase in crop yield was small and inconstant.

As it seemed nearly impossible to sift out the various possibilities working on a large scale in the field, later experiments were carried out, chiefly in the laboratory, or in pots, or in small scale plots. These experiments showed first that the very high voltages used in the earlier work, far from being necessary, were much less effective than much smaller ones. For instance, currents passing through plants of the order of one hundred millionth of an ampere were injurious in the case of the early vegetative stages of maize, whereas currents as low as three ten-billionths of an ampere had an accelerating action on growth.

It was also found that it was unnecessary to continue the discharge throughout the whole period of growth of the crop; but that one month's treatment was at least as effective as a continuous one. The second month of growth appeared the best time to apply the treatment. In one such case an increase in grain yield of 118 per cent. was obtained. It is interesting that in most cases of greatly increased grain yield the increases of total plant growth were very slight, indicating that the electrical discharge had stimulated the reproductive processes

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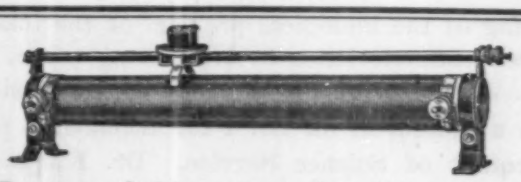

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of the plant without affecting vegetative growth. This discriminating effect was hitherto unsuspected. Finally, it was shown that the daily discharge can be reduced from six hours to one without reducing its effectiveness.

The discovery of these facts, making possible increases in yields, notably of grain, from discharges of lower voltage, of shorter total duration and given only for a small part of the day, has made the investigators quite hopeful that electro-culture may some day become an economic possibility.

THE NATIVES OF EASTER ISLAND

Science Service

DR. WILLIAM E. SAFFORD, economic botanist of the U. S. Department of Agriculture, in a report to the Bishop Museum of Honolulu, has presented plant and linguistic evidence in refutation of many fanciful theories woven about the lonely Easter Island in the South Pacific erroneously reported to have disappeared following the Chilean earthquake. He traces the kinship of the mysterious inhabitants of this tiny volcanic land with the people of the Malay Archipelago and finds indications that they are of much more recent origin than the various tribes of American Indians.

Easter Island, it has been claimed, was formerly inhabited by a strange race distinct from the natives of Hawaii and the other Polynesian islands. According to Dr. Stafford, however, among the plants introduced into Easter Island in prehistoric times there are a number whose vernacular names are identical with the same species in Hawaii and many of them can be traced to the Malay Archipelago, the cradle of the Polynesian race.

Attacking the theory that certain South American Indians are descended from the same race which inhabits Easter Island and that the island was a stepping stone used in the peopling of America, Dr. Safford stated that from the very close similarity of the dialects of widely separated tribes like the Hawaiians, the New Zealanders, and the Easter Islanders, and the identity of many of their myths, their gods and their calendar systems, it is certain that their separation from one another must have taken place at a very recent time when compared to the very ancient dispersal of the American stocks upon our own continent.

PROFESSOR KAMMERER

Science Service

AN airing of the biological problem of the inheritance of acquired characteristics is now taking place, Professor H. S. Jennings, of Johns Hopkins University, said to-day in a statement on Dr. Paul Kammerer prepared at the request of Science Service. Dr. Kammerer, an eminent biologist, of Vienna, is in this country on a lecture tour and his arguments and experiments in favor of the transmission of environmental effects have created considerable public as well as scientific interest.

"Dr. Paul Kammerer has carried on more extended and serious experimental investigations on the inheritance of acquired characters than any one else has ever done," said Professor Jennings. "For many years continuously he studied, mainly in amphibians and reptiles, the changes induced by altered environments on their instincts, markings and structural features, and the heritability of these changes. The accounts of these investigations are published with great detail in standard journals of research; they report that in many different cases such 'acquired characters' are inherited.

"In the interest of the solidity of science, any investigator who brings revolutionary conclusions, opposed to the common experience of workers in the same field, meets skepticism and thoroughgoing criticism; his work is not accepted until it has been sifted for all possible sources of error, and has finally been confirmed or refuted by the work of others. Though inconvenient, the history of science shows this to be necessary, and no investigator can escape it. Such a sifting the work of Kammerer is now undergoing. The materials with which he works are extremely variable in their genetic and other phenomena; some investigators hold it probable that unconscious selection among the variations, rather than the inheritance of acquired characters, may account for Kammerer's results. Attempts have been made to point out in his work errors, which, if they are typical, would raise a presumption of inadequate care in so difficult and complex a field; but none that are fatal to his general conclusions have yet been demonstrated. A number of investigators are repeating crucial parts of his work; until their reports come in a final judgment is not possible. Some eminent students of modern genetics feel certain of the overthrow of his conclusions; some eminent biologists in other fields believe strongly in their validity. If confirmed, the work would of course be of tremendous importance.

"The recent reports by Pawlow, Guyer, Stockard, Griffith, Kammerer and others show that we are in for another upheaval and airing of the problem of the inheritance of acquired characters. Since this is upon us, it is desirable that it be made as thorough as possible. Americans should therefore welcome the opportunity of hearing Dr. Kammerer's conclusions from his own mouth; experience has shown that the personality of the worker is not irrelevant in such fields to the question of how he came to his conclusions. The history of former upheavals of this matter does not predispose one to predict a favorable outcome of the test now in progress. But while we wait, Dr. Kammerer must be given credit for the most courageous and thoroughgoing attack that has ever been made of this important problem; for bringing to light many important matters, whatever their final significance; and for giving a powerful impetus to further investigations in this field."

NEW FUNCTIONS OF THE THYMUS GLAND

Science Service

ANNOUNCEMENT of the discovery of one of the important and hitherto unknown uses of the thymus gland was made by Dr. Oscar Riddle, of the Carnegie Station for Experimental Evolution at Cold Spring Harbor, N. Y., to the American Society of Zoologists at their meeting in Cincinnati on December 11. Dr. Riddle, who is on the staff of the Cold Spring Harbor Laboratory for

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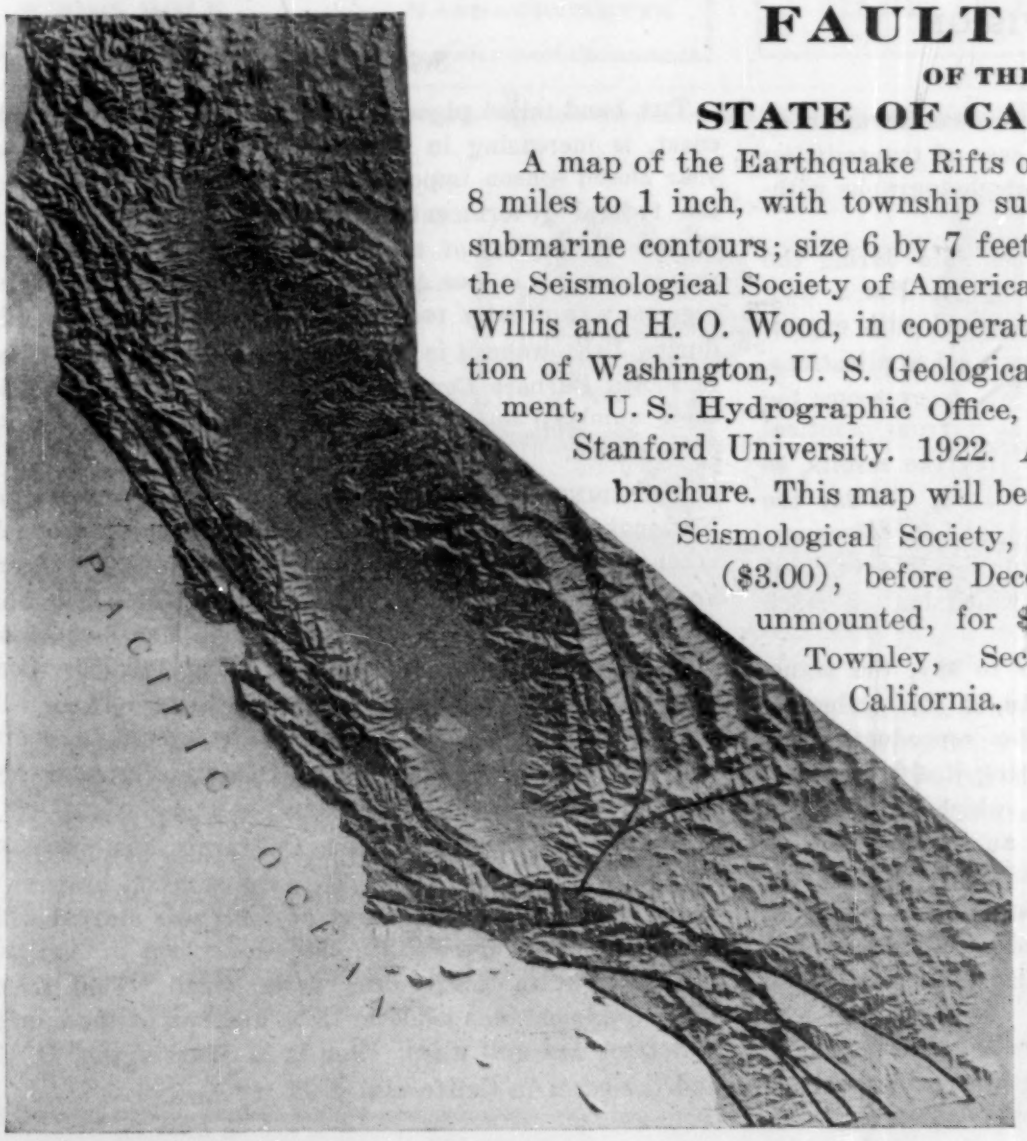

FAULT MAP

OF THE

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A map of the Earthquake Rifts of the State of California, scale 8 miles to 1 inch, with township subdivisions, relief shading, and submarine contours; size 6 by 7 feet, in four sheets. Prepared by the Seismological Society of America, under the direction of Bailey Willis and H. O. Wood, in cooperation with the Carnegie Institution of Washington, U. S. Geological Survey, U. S. Navy Department, U. S. Hydrographic Office, University of California, and Stanford University. 1922. Accompanied by a descriptive brochure. This map will be sent to all new members of the Seismological Society, who pay the dues for 1923, ($3.00), before December 31, 1923, or is for sale, unmounted, for $5.00. Write to Professor S. D. Townley, Secretary, Stanford University, California.

SEISMOLOGICAL SOCIETY OF AMERICA

Experimental Evolution, said, that, while of little use in human beings, the thymus gland was indispensable to the lower vertebrates in that it made possible the formation of egg membranes and shells.

While it had already been known, Dr. Riddle said, that the thymus gland in man had some influence on the growth of the bones, the new results show that the gland does produce an internal secretion, and that none of the vertebrates except the mammals could reproduce their kind without it. Pigeons which laid malformed eggs, deficient in membrane and shell, were given small doses of thymus extract and some afterwards began to lay normal eggs. Examination of the pigeon showed their own thymus glands to be diseased.

The gland lies between the heart and the breast bone. In childhood and in the young animal it is of very considerable size. It begins to diminish in size about the time of adolescence, but in human beings in general it persists throughout life.

"It thus becomes clear that though the thymus is almost without use in the human being, it is in fact a sort of 'mother to the race,'" said Dr. Riddle. "The higher animals could not have come into existence without it. For, even while our ancestors lived in the water, it was the thymus of these ancestors which made possible the production of the egg-envelopes within which the young were cradled and protected until they were ready for an independent life."

LONG-DISTANCE VISION

London Times

M. EDOUARD BELIN recently gave a demonstration at the Royal Society of Arts of the process of transmitting and reproducing writing, drawing and photographs without wires.

M. Belin stated that much had been said during the last few years respecting telephotography. For a long time past the inventors had been concerned with experiments in their laboratories and in practical applications. The latter had proved how difficult it was to overcome the obstacles which separated the laboratory from practical application, and that was the reason why the results, so long expected, had only now been achieved. To-day the object appeared to have been attained, and it was opportune not only to make it known, but also not to limit merely to telephotography a result which had so much wider a scope.

Besides telephotography, that was to say, the transmission at a distance of photographs, it also embraced teleautography, which concerned the reproduction of drawings, and especially of handwriting itself, by telegraphy. Lastly, there was television, which must not in any way be looked upon as simply an improvement on telephotography, but constituted a thing quite apart, which was nearly, and would soon be actually, vision at a distance, a problem long considered as chimerical, but to-day looked on as possible, and which to-morrow would be one of the realities.

Following a certain principle, inventors determined to resolve what seemed at the time the impossible problem of television. After recalling the names of the chief among them, it was well to mention the particular line of studies of the inventors who attained the result of telephotography. In all that had to do with the transmission of pictures, England had held an important place.

The Belin system of telephotography had to undergo many improvements in order to be not only of practical use, but also to respond to the actual conditions of the telephonic system. His system, which was now sufficiently well known, had led to apparatus which were equally adaptable to teleautography, for the use of which the French postal and telegraph authorities erected the first stations in Paris, Lyons and Strasburg. Messages thus transmitted were authentic, and even the transmission of shorthand would probably become general. An alternative application of the same system permitted absolute secrecy in telegraphic and radiotelegraphic transmissions. Autograph messages had been transmitted by wireless telegraphy in France and America, and quite recently he was able, with the aid of his assistants, to transmit by wireless real photographs in half-tones.

For several months, the researches in the laboratory at La Malmaison had shown in principle that television was no longer an impossibility. All the experiments were made with wireless, and M. Belin came to the conclusion that the expected solution of this problem was very near at hand.

ITEMS

Science Service

THE band-tailed pigeon, the wild pigeon of the Pacific coast, is increasing in numbers as a result of the ten-year closed season imposed upon hunters of the bird by the federal government. Formerly abundant, said Dr. Walter P. Taylor, of the U. S. Biological Survey, at a recent meeting in Los Angeles, the number of band-tailed pigeons was greatly reduced by over-shooting, especially during 1912, when it is estimated 30,000 birds were killed in Santa Barbara County. Now there is an increase in their number, and sentiment is being expressed for an open season.

ACCORDING to a recent census of big game in the National Forests, deer exceed the total number of all other animals. Their number is given as 440,000. There are 48,000 elk, 12,000 mountain sheep, 8,600 mountain goats, 4,600 moose and 3,000 antelope. The number of buffalo is second only to the deer, being 149,000. Conservation of buffalo is no longer an issue. There will never be sufficient range for them to be hunted for sport, and they are in no danger of extermination because they may readily be bred in captivity.

DURING the past five years, California has produced on the average over 8,000,000 boxes of navel oranges a year. All this golden harvest of fruit was started with less than twenty trees which the Department of Agriculture brought to this country from Brazil. That scientific experiment was made in 1870, and two of those original trees are still alive. One is in Washington, D. C., and the other in California.

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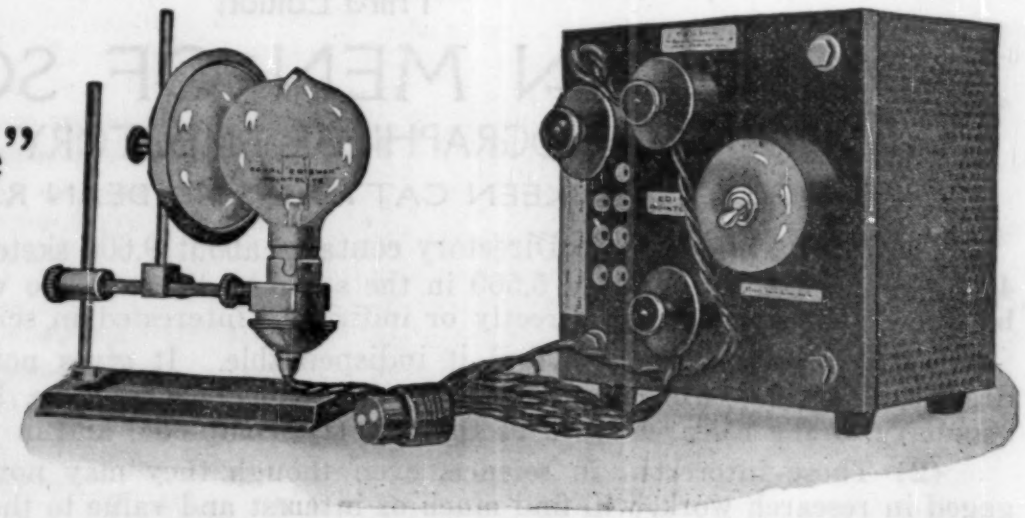

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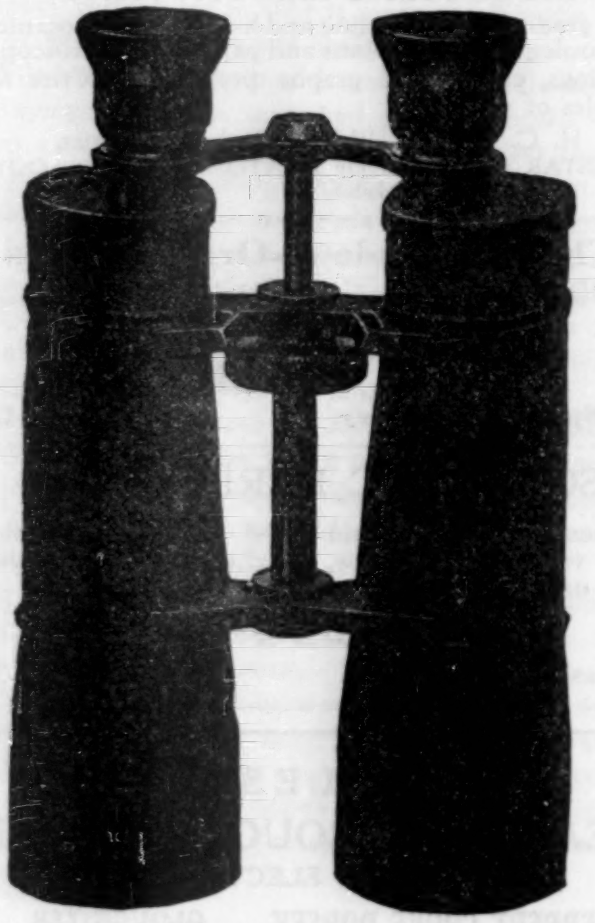

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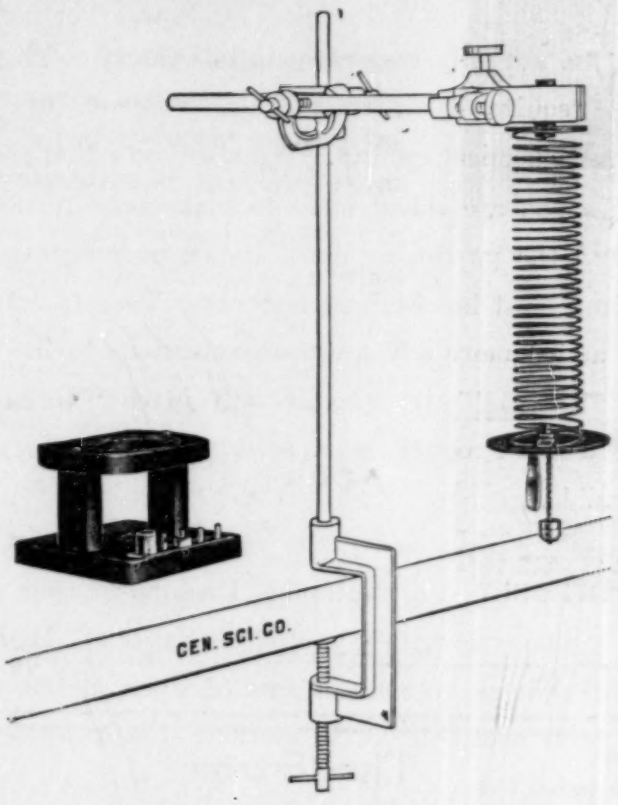

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